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SELECTIONS FROM THE RECORDS OF THE BOMBAY GOVERNMENT.

No. XIV.—New Series.

401 —

# MEMOIR ON THE PHYSICAL CHARACTER OF THE NERBUDDA RIVER AND VALLEY;

WITH REMARKS ON THE PRACTICABILITY OF THE RIVER BEING RENDERED A NAVIGABLE STREAM.

ALSO A DESCRIPTIVE DETAIL OF THE MINERAL RESOURCES OF THE NERBUDDA VALLEY; AND AN ANALYSIS OF THE PAST CORRESPONDENCE OF GOVERNMENT,

ON THE SUBJECT OF THE

# COAL BEDS IN ITS VICINITY,

BY SURGEON E. IMPEY,

BOMBAY MEDICAL ESTABLISHMENT.

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TO WHICH ARE APPENDED,

A SELECTION FROM THE RECORDS OF THE BOMBAY GOVERNMENT, 1838-1851,

RELATING TO THE NERBUDDA RIVER,

AND THE

# MINERAL DISTRICTS OF THE VALLEY;

AND

EXTRACTS FROM REPORTS

BY

MR. J. J. BERKLEY,

CHIEF RESIDENT ENGINEER, BOMBAY, OF THE GREAT INDIAN PENINSULA RAILWAY COMPANY;

AND

LIEUTENANT COLONEL J. P. KENNEDY,

MANAGING ENGINEER-IN-CHIEF, OF THE BOMBAY, BARODA, AND CENTRAL INDIA RAILWAY COMPANY;

With Accompaniments to the latter Report.

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AT THE

BOMBAY EDUCATION SOCIETY'S PRESS.

1855.

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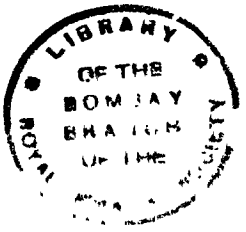
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THE
VALLEY OF THE NERBUDDA
Shewing the Principal Falls and Rapids in the
Course of the river of the Coal and Iron Mines

# MEMOIR

ON THE

# PHYSICAL CHARACTER

OF THE

# NERBUDDA RIVER AND VALLEY;

WITH REMARKS ON THE PRACTICABILITY, OR OTHERWISE, OF THIS RIVER BEING RENDERED A NAVIGABLE STREAM.

# NERBUDDA RIVER AND VALLEY.

AMONG the varied and important subjects that are presented for the consideration of Government, few could be more appropriately selected, or better calculated to interest the public, whether in a commercial or scientific sense, than those which tend to develope or display the resources of unknown or imperfectly explored parts of the Indian Empire, such as the accompanying papers refer to.

There are few, perhaps, to which the utility of publicity is more happily applicable, or in which substantial advantages are more likely to revert to the governing body, than the promulgation of records which afford either public officers, or more directly interested persons, the means of acquiring information thereon.

It seldom happens that official proceedings, which are for the most part conducted with some specific intention, and limited to one object, contain an epitome of previous information connected with any given subject, which often extends over lapses of years and voluminous detached records: it is scarcely reasonable, therefore, to expect that the formal nature of official correspondence is sufficiently interesting to invite lengthened or patient perusal; hence the arrangement and abridgment of a series of papers may have an instructive as well as an attractive tendency.

The *objects* of the present records are, the exposition of the navigation of the Nerbudda, and the mineral resources of a portion of the valley of that river. The period included is from 1838 to 1854.

The *subjects* are, the actual descent of the river with a small cargo of coal; the sinking of a shaft at the Nerbudda coal-fields; the experiments and trial of the coal in Bombay; its proven good quality; and the exposition of the capacity and richness of the district through which the railway is about to run.

That these subjects, so often adverted to, and more than hinted at by officers locally employed, should have remained so long in abeyance, seems at first glance matter of surprise, and has been flung at Government as expressive of laxity and disregard on their part for the material benefit of the country, and of the civil benefits which attend the opening of river navigation everywhere; but it is not to be forgotten that other interests were at stake besides the gratification of a quasi popular demand, and it may be demonstrated that

it was not without reason and information, foresight, and, it may be added, *justice*, that the navigation of the Nerbudda has been left out of the reckoning of the great works which have engaged public attention.

In a country where trunk roads have been, and are deficient, the value of any river navigation, having a shadow of practicability, could never be overlooked, whether in relation to its influence in assisting the efforts of human industry, to the facilities it affords for conveying the produce, and supplying the deficiencies of distant parts, or of exciting the internal trade (in all accessible directions) of neighbouring provinces, whose products admitted of exchange,—the very foundation and essence of all trade. In point of economy also, attention would naturally be directed to any expedient which promised —as water-carriage ought—a saving of one-fourth the cost of roads, especially from districts teeming with the most luxuriant cereals and grains, dyes, woods, and cotton, besides inexhaustible quantities of valuable minerals—as iron and coal—of the very richest quality.

To argue that such afforded no temptation or inducement to a Government never niggardly inclined, and that such would be foregone without an attempt to realize it, either in the way of experiment, or in the more cautious and practical form of inquiry, is to believe our rulers insensible to the sentiments which guide ordinary men in the regulation of their interests.

It may be found, however, that their apparent supineness has been based on good grounds; for the Nerbudda, in its physical characters and features, presents such insurmountable obstacles to ordinary calculations, that it may safely be said to be impracticable as a navigable stream; and its valley, so much lauded, is for several hundred miles, in detached portions, a barren, hilly, and uncultivable jungle. The great agricultural districts referred to lie north of its upper portion, while the chief mineral ones stretch over the south bank of one of its central basins, from 250 to 500 miles from the sea; in which distance its free navigation, far from equalling that of ordinary rivers, which is at the least one-fourth of their length, scarcely extends beyond its limited tideway of twenty-five miles, through the year round.

A description of the course and general character of the Nerbudda may not therefore be uninteresting, and may tend to dispel some of the debatable points which have obscured it, and which a glance at the accompanying map may aid. It will be seen that, from its source to its debouchure, the Nerbudda is closely bounded on both banks by two ranges of high hills, from 200 to 2,000 feet high: these are the Vindhyan and Bander Mountains on the north bank; the Satpooras, Kalygong, and Mahadeo Hills on the south;—the two great ranges which cross Central India, and which have elevated spots, such as Amurkuntak, 5,000 feet; Pachmari, 3,000; Mainpat, 2,700; and Jam Ghat, 2,000 feet high.

In no points continuously are these ranges distant from the river above forty miles, the average being eighteen or twenty; and they run parallel to it through its whole length. In its upper portion, from Mandla, and almost from Amurkuntak,

to Jubbulpore; in the centre from just below Hindea to Burwye; and lower down, from the Hurun Pall to Mokree, the hills close in so narrowly as to form absolutely the banks of the river. The abrupt face of both these ranges is to the south, their declivity and principal water-shed to the north. The great affluents which supply the river are consequently furnished from the northern aspect of the southern range, the northern feeders being comparatively smaller, fewer, and shorter.

The proximity of the hills increases the number of these feeders, adds immensely to their volume and velocity, and accounts equally for the sudden flushing of the river in the rains to seventy and ninety feet, often in a few hours, and also for its shallowness in the fair season; the tributaries being literally the drainage of the mountain ranges, which rapidly empty themselves, owing to their short course and rapid fall: their rugged and precipitous nature, in fact, makes them torrents rather than streams. Of their size, some idea may be gathered from one (the Towah), whose flood area is stated by Mr. Berkley to be 1,276 yards from bank to bank in the rains, while it is all but dry in the fair weather. The Kârun also, near Goojree, on the north bank, is nearly as wide, requiring a bridge of five large eliptical arches to span it.

The Nerbudda, then, rising in the highest land of Central India, 5,000 feet above the sea, and pursuing a serpentine westerly course for 750 miles through a hilly tract, which runs parallel to, and borders closely both its banks, may be said to flow through a longitudinal cleft rather than a distinct valley, and to present the general characters of a mountain stream more than anything else. No great depth of water can ever be expected in it, from the nature of its tributaries, except in the monsoon; neither, were they to promise better, could it be retained, owing to the great declivity of the bed of the river, which from Jhansee Ghat, near Jubbulpore, to the sea, falls 1,200 feet in 500 miles. So short a course, with such an extent and approximation of mountain region, precludes, *à priori*, much internal navigation, which implies length, and little elevation. In this respect the Nerbudda resembles similarly circumstanced rivers in mountainous countries, as in the north of Scotland, Sweden, Norway, and the West Coast of America, the rivers of which are useless for purposes of navigation. Unlike even the rivers of India, it has no lower or level portion, except for about sixty to eighty miles from Tullukwara, or Mokree, to the sea, and even in that distance it is interrupted at low-water by several rapids.

Its great declivity from its source to its debouchure would seem of itself to augur extreme rapidity as fatal a point to navigation as want of water, and creative of the latter; for were the descent direct and gradual, it would involve a fall of 6¾ feet to the mile. The Godavery (Colonel Cotton states) is 2 inches; the Amazon, 700 miles from the sea, .02; and the Ganges about 1 foot per mile, 800 miles from its source. Since, in the flow of water, a fall of twelve inches per mile is equivalent to a current of one mile per hour, that of the Nerbudda would have an estimated flow of nearly seven miles, sufficient to drain off the monsoon supply many times multiplied.

In the rains, Captain Evans computed the current to be six or seven miles; Captain Fenwick eight or nine miles. In the dry weather, Lieutenant Keatinge found it from three to four; for he performed the journey from Dharee to Oonkar, twenty miles, in five hours; and from the latter to Mundlaisir, thirty miles, in ten hours, by the strength of the current alone, the wind being unfavourable, and against stream. The decline of the river is not, however, a gradual slope, but is intercepted by ledges, and drops off from ten to forty feet, which divide its form and valley into natural basins, in which the stream is slower, the banks high and alluvial, and shoals and fords are found, owing to the débris brought down by the force of the tributaries.

Within the first 250 miles, the extreme elevation of the table-land leads to a very rapid descent of upwards of 3,000 feet, for Jhansee Ghat, 500 miles from the sea, is barely 1,300 feet above its level; Mundlaisir, 210 miles from the coast, is 698 feet; Chikulda, 150 miles, 583 feet; which would indicate a decline of nearly three feet per mile for the bed of the river, and a corresponding increase to the velocity of the current, whose rate is, however, never uniform or steady, in consequence of the number of drops and ledges, deep pools, and rapids, which obstruct it.

The first of the great perpendicular descents occurs somewhere near Mandla, 150 miles from the source of the Nerbudda, and is said to be ninety feet; but very little is known of it. A small one of ten feet is also said to exist opposite Omeria, and the mouth of the Thain river. The second large fall Lieutenant Keatinge describes at Mundhar, twenty-five miles below Hindea, and to be forty feet, preceded by two miles of great incline. A similar fall of forty feet occurs at Dharee, twenty-five miles lower, from which there is a tolerable level for sixty-five miles to Sahesur Dhurah, where a small fall of ten or fifteen feet is met. For seventy miles further there is again a tolerable level, obstructed by numerous shoals and rapids, until the hills close in at the Hurun Pall. From one mile below this to Mokree, where the jungle ceases (a distance of eighty miles), there is a constant succession of less remarkable but still serious obstructions, extending from a few yards to several miles, consisting of rapid inclines, barriers, and the projection of immense rocks, with a rushing stream. The immediate fall over any one of them is not much, but on the whole is 300 feet in the eighty miles; and as they occur, with one exception (Sahesur Dhurah), in the heart of an extensive jungle, and masses of rock form the banks, and protrude in the centre of the bed, they seem to admit of no reasonable removal.

If such grave obstacles present difficulties, the apparently minor ones are scarcely less serious. The bed of the river in its whole length is one sheet of basalt, seldom exceeding 150 yards in absolute width, which has been upheaved in ridges, which cross it diagonally in NE. and SW. directions. These elevations occur every few miles, and cause a kind of natural bund, above which the water is invariably formed into a pond more or less deep, is very shallow over it, and runs rapidly off.

It is this peculiarity of geological and physical formation, creative of so

many natural barriers, which gives rise to the numerous fords which, in all the open and cultivated parts of the Nerbudda Valley, are found occurring every few miles, with a town on each bank; and their very existence indicates the absence of any extent of navigation, which can only be absolutely free between limited intervals.

In such a condition of the bed, the only change produced by time is due to the erosion of the water, whose course being straight, and the force of its accessary feeders so strong, is much obstructed by the deposit of sand and detritus, which the transporting power of the monsoon brings down, and carries to spots where some natural impediment arrests them, or where the rapidity diminishes.

Thus, where the Nerbudda is closed by hills, its breadth less, and the vehemence of the entering streams intense, the rush of water furnishes and lodges the large erratic blocks of débris, which the different natural rocky barriers stop, and which contribute to the formation of rapids, and to the decrease of water over them in those places.

But in the larger basins, where the banks are high, and of alluvial and vegetable character, the hills further distant, and the impetuosity of the flood is lost, the larger débris are left behind; and the detritus, consisting of light gravel and sand, subsides, and accumulates more, opposite or just below the entrance of the large tributaries. The character, then, of the bed of the Nerbudda, in fair weather (independent of the large falls), may be summed up as consisting of a narrow rocky channel, obstructed by numerous rapids, occurring in the openings of the bare rocky ledges which cross it diagonally. These rapids are tortuous, often at right angles with the general course of the river, and from fifty yards to five miles in length, very shallow, and rendered still more so by the accumulation of sand, rock, and gravel deposited at the mouths of the numerous feeders, which cause a broken eddying current, with from six inches to a foot and a half of water over them, and are not safe (in consequence of projecting rocks) with a rise of twenty feet of water, at which time formidable whirlpools, and a strong unmanageable current, subject to freshes of thirty feet in a few hours, take place.

In the 120 miles between Dharee and the Hurun Pall, there are thirty or forty of these minor obstacles, over which Captain Fenwick had either to lighten his boats of their loads, to enable them to float, or to ease them down with drag-ropes. The Nerbudda boats being flat-bottomed, and without keels (their established form for ages), but adds additional testimony to the accepted character of the river for shallowness.

The basins of the Nerbudda are those portions of the valley which are so fertile and productive. The upper one, 1,000 feet above the sea, extends from the marble banks of Beira Ghat, opposite Jubbulpore, to a little below Hindea, nearly 200 miles in length, but of little width northerly and southerly, the hills being nowhere above twenty miles distant.

The other great basin, 500 to 750 feet high, stretches from the quartz hills

above Burwye to Chikulda, upwards of 100 miles—it is more open; the Satpoora range, in some places forty miles distant, to the south; on the north the Vindhyas approach to between fourteen and sixteen miles.

The banks of both basins are forty feet high, the soil alluvial, composed of marl and clay below, the superior stratum being the black vegetable mould. The upper basin is so level, that from Jubbulpore to Hooshungabad, upwards of 120 miles, the fall is little more than fifty feet. In the lower, the fall averages about 200 feet. The centre of the latter is nevertheless nearly 400 feet below that of the upper, Mundlaisir being 700, and Hooshungabad 1,070 feet above the sea; and Tullukwara, in the inferior or third basin, 100 miles lower down, is 450 feet lower than Mundlaisir.

These successive steps, as it were, are occasioned by the perpendicular falls that intervene, that is from below Hindea to Burwye, and from the Hurun Pall to Mokree, and also above Jubbulpore.

The true Valley of the Nerbudda may therefore be confined to the undulating districts of these basins, which have evidently been marine lakes. In troughs in them, the sandstone and lime have been deposited, and the coal-measures and minerals formed, but principally in the upper. In the lower, sandstone is met only at one place, Baug: from its carbonaceous colouring and admixture,—the lime and associated clay-iron of the coal-measures,—coal will doubtless be found in the neighbourhood; if so, its height 300 feet above Chikulda, and 850 above the sea, point to identity of formation and qualities.

It is only in these comparatively level parts that anything approaching to free navigation can exist. In the hilly districts, until within the last few years, very few roads or means of intercourse existed, and the country was infested by wild tribes of Gonds and Bheels, who were at deadly feud with the British Government. As late as 1841, Captain Anderson's boatmen refused to proceed twenty-five miles below the Hurun Pall, for fear of Bamun Naique, a Bheel Chief. Again, as to population, that of the fertile tracts of the Saugor and Nerbudda Territories, in the immediate Valley of the Nerbudda, was until recently very scanty: in Nimar it was computed (fifteen years ago) at thirty-five to the square mile; and any increase sufficient to represent extended capital must be a work of time.

The ulterior objects of any system of river navigation, to be of solid benefit, or to be complete, or permanent, should have reference to such vital points; and it would scarcely savour of discretion, or judgment, to attempt, with the above data, large undertakings in a river, the inclined plane of whose bed is so great, and the velocity and drain of whose current (though equalized by interruption of natural bunds) is four miles per hour;—where no assistance can be counted on from winds, which are generally adverse, and blow for the most part against stream;—in which, in dry weather, scarcely one foot of water can be insured throughout, over its numerous rapids, formed of solid rock, where obstructions of such magnitude as falls of forty feet occur, and hills and forests form the banks for miles;—where the monsoon freshes rise to seventy and ninety feet, and the proximity

of the hills render their currents impetuous to a degree, and fatal to any closed masonry, except that of the most substantial nature; where the paucity of the population and wealth in the immediate vicinity constitute little to hope from lavish local expenditure, and the territories on the banks do not even pertain to Government, but to Native States interspersed with them; and where, if free navigation were effected at a great cost, it would still be precarious and unsafe, and lead to the questionable result of the diversion of the trade to another sea-port, shut up for three months of the year, and to the substitution of it in place of the capital of the Presidency, for the trade of Central India and Guzerat.

The fact of no single river in India being, as yet fairly navigable, that depends for its supply of water on the monsoon, and that none in the world in the immediate neighbourhood of mountains are so, is incitive of little inducement to an over-burdened Government to experimentalize by preference at the prodigious cost which locks and canals would impose. Colonel Cotton states that a single weir across the Godavery cost £200,000; and the large and far-famed waterworks in Upper Canada, the Rideau and Erie Canals, which are, properly speaking, rather a succession of raised waters by means of dams, cost from two to six millions sterling. The differences of level are, however, only 445 feet, and the gain a water depth of five feet, opening a communication of 150 miles, which is effected by forty-seven locks, the largest converting only seven miles of rapids (flowing from comparatively still lakes) into navigable water.

In the Nerbudda, on the contrary, the difference of level is at least 1,200 feet, the length 500 miles, and the sudden impetus of the flood likely to be destructive to almost any masonry. An example of the difficulties to be encountered in the latter respect has been before the public of Western India, in the construction of the Jamsetjee Bund over the Motee Moola, near Poona, a stream not one-third of the size of many of the tributaries of the Nerbudda, and no closer to the hills.

The large reaches and beautiful sheets of water scattered over different spots at Jubbulpore, Hooshungabad, and Mhysir, and the slight fall in the basins of the river near them, never fail to excite in every beholder a general feeling and exclamation of pity that partial attempts have not been made to render limited portions of the river improvable; but the great objection is the perpetual recurrence of the expense, as far as refers to the removal of rocks and débris. The decline of the bed is so great, and the material of it so devoid of softness, that any decisive deepening could only be effected by the expensive process of blasting; and when accomplished, and gaps literally cut in the rocky barriers, the effect would be to drain the pools completely, and to establish a greater velocity, which the little elevated ridges now equalize. Artificial bunds and dams would thus be required, in place of the natural ones, to prevent the entire exhaustion of the water of the river.

Viewed in another aspect,—that for irrigation,—the Nerbudda presents scarcely more favourable characters, except that in this case the chief sources of

one evil are counterbalanced by the facilities they admit of otherwise. The banks in the fertile districts being high, and their level trifling, irrigating canals supplied by the river would have to traverse long distances, to obtain sufficient flow in the lateral channels. In lieu of this, the great number of the nullas and small streams, passing in their course through hills and ravines, admit of being bunded at slight cost, and their inclines afford ample and inexpensive slopes for irrigation, and for the formation of tanks and reservoirs. Of this the utmost advantage has been taken for some years in the administration of Nimar, under Sir R. Hamilton, by Major French, Captain Evans, and Lieutenant Keatinge, new tanks having been constructed wherever the population and soil required it, and every old one repaired; and with the usual result—quadrupling the population and revenue in their neighbourhood.

Reverting to what has been actually accomplished on the Nerbudda in the way of navigation, and to the records published. Unfortunately 300 miles of the upper part, indeed as far as Hindea, has not absolutely been traversed, or if so, no report of it is extant. From Ramnuggur, near Amurkuntak, to Mandla, it is reported navigable, but is not made use of, except for local purposes; thence to Jubbulpore is unknown. As the hills approach the banks closely there, it may be surmised to be of the same character as parts similarly circumstanced in its course elsewhere.

From Jubbulpore to Hooshungabad and Hindea, it is believed to be open for boats of light draught, one fall of ten feet only existing, opposite Omeria. Colonel Ouseley endeavoured to have it surveyed, but his party was attacked by the serious remittent fever which the jungles give rise to.

From Hindea (from which Lieutenant Keatinge went down), the river is not applied to navigable purposes, except at the ferries. It is, however, unusually favourable as far as the Ajnal river, twenty-five miles: there it is double its ordinary width, and divided into shallow streams, running between rocks and jungle, with so great an inclination as to give it the appearance of a collection of mountain streamlets, which are concentrated into one large deep pool at the head of the Mundhar falls, which are nearly forty feet in perpendicular height. Thence to Dharee, twenty-five miles, it presents the usual character of pools and shallows, hemmed in between high rocks to one-fourth of its width, with rapids at every mile. It is, in fact, only just passable for fifty miles, which occupied Lieutenant Keatinge nine days. At Dharee the rock is in abrupt, irregular steps of from ten to fifty feet, and a road could not be made, even to the water's edge. The portage distance is 1,490 yards.

From Dharee to Mundlaisir the river presented little difficulty, and was traversed in sixteen hours against wind, both in the months of March and August, on the latter occasion with twelve people in the boat, and a good load of luggage.

Captain Fenwick proceeded over this route in the month of April, on the 5th of which he left Dharee, with fifteen tons of coal, in boats having a draught of two feet and a half. He reached Mundlaisir in seven days, the

difference arising from the laden boats. He met with several rapids and shoals, in four of which his boats were let down, or dragged by ropes.

From Mundlaisir to Chikulda the river has been descended by Captains Anderson and Evans: both officers accomplished the distance, fifty miles, within two days; it took Captain Fenwick nine.

The general character is the same as from Dharee, namely numerous shallow rapids, with loose stones, and seldom one foot of water over their narrow winding channels. The only great obstacle is the Sahesur Dhurah fall, a belt of rock stretching diagonally over the river, and precipitated over a shelf of eight or ten feet, with a back-water on the south bank. The portage here would be about 1,290 yards. Captain Fenwick's empty boats were eased down with ropes, and the coal carried on coolies' heads. He refers to ten or twelve difficult spots, in three of which drag-ropes were needed; he however landed and stored his whole cargo at Chikulda.

The distance between Chikulda and the sea has only been performed twice—on both occasions in the monsoon. It is perfectly impracticable in the hot weather, either up or down, and is by far the most dangerous part of the river; the number and extent of the rapids, whirlpools, and rocks, the velocity of the current, and the amount of jungle, rendering it most perilous and hazardous, and not to be attempted under a rise of twenty feet of water.

Captain Evans accomplished the distance, 160 miles, in 102 hours' sailing, though actually nine days under way. He describes five great obstructions, the Bhorekeyree and Gunoee Ghat rapids, near the Hurun Pall; the Beytana barrier and belt, twenty miles further, resembling the Sahesur Dhurah; the Balaghori rapid, near Hamp, four miles in extent; and the Mokree falls of ten feet, six miles from Soolpan,—which, owing to the height of the river, were shot, and were scarcely perceptible. Captain Evans recommends portage at Sahesur Dhurah, and the Hurun Pall and Mokree. Hence to Tullukwara the river is clear. From the latter to Broach, navigation is not open till September, and boats take five days. In a low condition of the river, there are seven small Ghats in this distance, and the journey extends to fifteen days. Captain Fenwick, with his cargo, took three days longer to perform the journey from Chikulda, the water being considerably lower. He lost one-third of his freight, and several boats, and states his conviction that there is not a mile of free navigation on a stretch between Hurun Pall and Mokree, eighty miles; and that his cargo was exposed in a manner that would be ruinous to more perishable goods. One boat was lost in the Bhorekeyree rapid, near the Hurun Pall, and two others at the Balaghori rapid, below Hamp, notwithstanding that his arrangements were most cautious and practical. He encountered several difficulties which Captain Evans did not, owing to the water being lower: the Dupána fall, Hailkuree Ghat, Gulchee Ghat whirlpool, Nunka Ghat, Selukda belt, and Peepul Chope rapids, above Soolpan. The nature of these impediments are best learned from Captain Fenwick's Report. They were generally rapids from a hundred yards to four miles in length, and from ten

to fifteen feet incline, studded with rocks in mid-channel, the avoidance of which was prevented by the vehemence of the current.

Sir Robert Hamilton, with whom the impulse and care of this second attempt originated, comes to the conclusion that the river is impracticable for navigation; that from August to December, it might be facilitated by nautical science, and be made use of in this its worst portion, but not from January to June. To test it further, Captain Fenwick returned by water to Chikulda in the monsoon, and reached it with extreme difficulty in forty-three days.

To sum up: it appears demonstrated, that in the fair season, 100 miles of the middle portion of the river only is navigable if cargo is carried, not without having recourse to portage and drag-ropes; and that it is just possible to descend in the monsoon another 100 miles with extreme danger, and possible destruction to life and property. The forcible conclusion is, that the danger, risk, and uncertainty which are inseparable from the navigation of the Nerbudda at present, are all incompatible with that steadiness which should attend a branch of industry and trade which, more than all others, needs a certain and speedy mode of delivery to ensure success, or gain encouragement, and affords little hope to the realization of such projects as Mr. Bourne propounded with his steamers of twelve inches draught, 250 tons of cargo, and a speed of fifteen miles an hour.

Such was the result of an experiment to determine a point which was raised as far back as 1833, which was never lost sight of by the Resident of Indore, which the Bombay Government supported with alacrity, vigour, and prudence, and which involved no small amount of peril and enterprise to the energetic officers who undertook it.

# DESCRIPTIVE DETAIL OF THE MINERAL RESOURCES

OF THE

# NERBUDDA VALLEY.

# MINERAL RESOURCES OF THE NERBUDDA VALLEY.

REGARDING the mineral resources of the Nerbudda Valley, there may be said to be the minimum of accurate information; and until a scientific geological survey by qualified officers regarding it is instituted, it must remain to some extent conjectural.

The estimate formed of them is, however, large,—the latest reporter, Mr. Jacob, declares them to be inexhaustible; and certainly, if variety, and extent of space,—comprising two hundred miles in length and thirty-one in width,—identity of geological formation, and other accessary characters, have any weight in leading to an assumption, it is not ill-founded.

It is, however, chiefly in the upper basin, between Jubbulpore and Hindea or Dharee, that the principal mineral products abound, though they are not wanting further down in the lower; and their order, both in respect to geological succession, and to the more important relation of commercial utility, renders this portion of India (circumscribed and excluded as it is, by distance and want of roads, from intercourse with the seats of commerce) probably the most favoured of any known district, and on a par, if not more advantageously circumstanced, in some respects, than the richest coal district in England, viz. Dudley, where, as at the Nerbudda, the combination of fuel, flux, furnace clay, and metallic germe, exist side by side. Irrespective of the fertility of the soil, with its abundantly productive crops of every description, which have not been in the least overrated; of the grains which, for want of market, sell for 120 to 160 seers per rupee; of the dyes, sugar-cane, cotton, opium, and oil seeds; astringent barks and aromatic plants; of the proximity of forests, which furnish timber of the most enduring nature for building purposes, as well as denser kinds for charcoal and rougher work, also lac, gums, and resins: independent of these, which form no inconsiderable item of at least local transport, the mere mineral and natural productions certainly appear inestimable, if not exhaustless.

Besides coal and iron, many minor but profitable and much needed productions exist: lithographic stone and statuary marble near Beethári Ghat and Ponassa; roofing slate thirty miles from the river at Kuan; also traces of copper, and it is said of antimony, near Hurda. The former, however, and their associated rocks, are the most material; and seem to belong to, and to be

contemporaneous with, the great belt of coal which stretches across India, from Arracan and Rajmahal east, to Kutch west. It traverses the entire continent, forming the fields at Cherapoonjee, Burdwan, Palamow, and Sohagpore and the Nerbudda, and follows (if its appearance is not dependent on) the great volcanic energy which was excited in this direction. In the last-named place it occurs, as usual, in troughs, about 1,000 feet above the sea, and is an example of the generic law, that the best coal is that found at the greatest altitude, having been formed at the greatest depths, and been upheaved with the rising of the mountains on the flanks of which it outcrops.

The Cherapoonjee coal, 4,300 feet high, affords an illustration, being ascertained to be the best in India; and with it the Nerbudda coal is identical in character, and associated rocks. In the upper basin of the Nerbudda, it is found in numerous places, but at three principal spots: at Jubbulpore itself; Lemáta Ghat, where the Nerbudda runs through a vein; on the banks of the Sakur and Towah rivers, and their feeders,—at Mowpáni and Kotra on the former, at Sonádeh and Mardanpore on the latter. Also at Patroda, and around Hooshungabad, where it is supposed to abound, the most distant fields not being thirty miles in a direct line from the river. Further and more diligent search would doubtless lead to the discovery of many more seams; for the whole valley, though undulating, is of the same geological character, with limestone underneath,—affording a further proof of the nature of the Nerbudda coal as applied to Indian fields,—the best being found so; those in which inferior coal appear, as Burdwan and Rajmahal, being devoid of it. Up to the present time, the only connected description of the Nerbudda coal is that given in the Coal Committee's Report, published ten years ago. The three beds as above, are reported to have the same geographical character as the Cherapoonjee and the best Scotch Clackmannan coals; they are from one to forty feet thick, alternating with sandstone and shale of various thickness. The outcrop is everywhere close to the surface, and is often exposed by rivers, whose beds intersect it: this occurs both at Sonádeh and Mowpáni. The field at the the latter place is not far from Gurrawara. The seams are said by Colonel Ouseley to be from twenty to forty feet thick, by which it may be presumed is to be understood the total thickness of all the seams, and not individual ones. Mr. Jacob makes the three seams as follows :—

| | | | | | |
|---|---|---|---|---|---|
| First ..... | 8 | feet | 6 | inches | thick, |
| Second ..... | 3 | „ | 6 | „ | „ |
| Third ..... | 6 | „ | 3 | „ | „ |
| Total.. | 18 | feet | 3 | inches; | |

and all highly inclined, owing to trachyte veins; he characterises them as highly bituminous lignite, having no sulphur, and little residue. They are found on both banks, from 20 to 25 feet in depth, 84 yards in width, and 127 yards in length along the river, with only 6 feet of sandstone above. The Kotra bed, near the

confluence of the Hurd and Sakur rivers twenty miles eastward from Benár, has three seams from one to four feet thick. At Jubbulpore station, coal occurs at a depth of seventy feet, also at Lemáta Ghat.

The Bethári Ghat cuts a pyritous coal-field, inclined at an angle of 80°, overlaid by dolomite, and the analysis of both shows the properties to be as follows:—

| Sp. gr. | Vol. Matter. | Carbon. | Ash. |
|---|---|---|---|
| 1.49 | 50.0 | 47.1 | 2.9 |

At the Towah field is the mine which was worked by Sir R. Hamilton, close to Sonádeh, and thirty-four miles from Sewnee; coal exists also at Mardanpore, forty-two miles from Shahpoor, in seams of twenty-one and twelve inches thick. The superficial limit of the former is said by Mr. Jacob to be fifteen miles by seven, at an angle of 7½° N by E., and twenty inches thick, between layers of shale and sandstone, and covered by a coarse sandstone thirty feet in depth, with a deposit of fine clay. Three or four fields in this neighbourhood are exposed by the nullas, and it was from these and the Benár fields that the specimens were sent by Colonel Ouseley and Sir R. Hamilton to Bombay, for trial and analysis.

From the above outline, it may be supposed that the seams are of the kind best suited for mining: the pits are shallow; and as depth regulates the power and diameter of machinery, no extensive working will at first be necessary;—elaborate means for ventilation and drainage may to a certain extent, therefore, be dispensed with, as these operations can be effected by more simple contrivances. The water-power from the neighbouring nullas would be the supply best adapted; but Mr. Jacob asserts that the drainage may be effected still more simply by adits. Colonel Ouseley and Mr. Jacob, speaking from personal inspection, believed the resources to be as unbounded as the most sanguine could imagine. From the thickness of the seams, it may be surmised that they are equal to the most extensive demands that can be made on them for years to come.

The quality of the Nerbudda coal enhances the value of these opinions. It has on all hands been admitted to resemble the Cannel coal of the British or Scotch mines, and is consequently a bituminous variety. However much high authorities may differ as to the value of a chemical analysis of coal, and its bearing on the calorific powers of given specimens, yet as all artificial heat is obtained from, and depends on, the combination of carbon and gaseous products which a coal contains, those specimens in which they are determined to exist in the largest quantity, and show a minimum of ash, or incombustible and infusible material, must be the best adapted as fuel; and it has long been settled that a bituminous coal, in consequence of the heat evolved by the volatile combustible matter (the important element of hydrogen being three times more powerful than the carbon itself), gives 20 per cent. greater heat than from its own coke, which is chiefly advantageous for its great weight comprised within the small space it occupies, and for the expulsion of sulphur

and impurities in its manufacture. The Nerbudda coal has, however, had the advantage of the minute analysis and induction of the chemist as well as the practical knowledge of the stoker; which latter may be assumed to be the most essential investigation, intelligent stokers only being able to treat fairly and openly different kinds of coal, according to the very different modes of firing each needs: a coking and gaseous coal, for instance, not taking above a few inches of fuel in the bars, and small supply of air; a carbonaceous variety, as anthracite, requiring twelve and fourteen inches, and large supply of air. The Coal Committee determined the coal to consist of—

| Coal. | Density. | Carbon. | Gaseous and Volatile Matters. | Ash, and Mineral Constituents. |
|---|---|---|---|---|
| Benár coal .. .. .. | 1.49 | 47.0 | 50.0 | 2.9 |
| Jubbulpore coal .. .. | 1.30 | 37.0 | 59.0 | 4.0 |
| Dr. Giraud's analysis of former | .. | 41.0 | 34.0 | 24.0 |
| English West Hartley.. .. | .. | 54.0 | 37.0 | 8.0 |
| Sonádeh coal (Dr. Giraud) .. | .. | 38.7 | 35.3 | 26.4 |
| Edinburgh coal .. .. | .. | 67.5 | 17.8 | 14.5 |
| Dr. Ure's ditto .. .. | .. | 57.0 | 37.6 | 5.0 |

The Indian specimens, with the exception of the first two, would seem to have been inferior, and were known to have suffered from exposure to heat and damp a long while, and to be pulverized. The analysis of such would necessarily be unfavourable, and the quantity of ash large; on the above grounds therefore the comparison was scarcely fair. The Benár coal sent by Colonel Ouseley had, previously to the last analysis by Dr. Giraud, been tried in comparison with Glasgow coal practically on the *Indus* steamer, in Bombay harbour, by Captain Turner, with engines of 60 horse-power, 3-feet stroke, 4½ feet in diameter, giving 26 revolutions in a minute, and for a distance of 22 miles, with and against tide, with a speed of 9¾ miles, and 2¼ hours employ, and the result was:—

| Coal. | Time in getting up Steam. | Quantity of Coal used. | Ditto per Horse-power. | With both Boilers, of same Coal, per Horse-power per Hour. |
|---|---|---|---|---|
| | Hours. | Cwt. lbs. | lbs. | lbs. |
| Glasgow .. .. | 1¾ | 5 20 | 19¼ | 13.96 |
| Nerbudda .. .. | 1½ | 2 92 | 10½ | 11.65 |

The Nerbudda coal was therefore 83 per cent. better in raising and keeping up the steam than the Glasgow coal. It gave little ash; but its defect was a good deal of clinker on the fire-bars, having been taken indiscriminately dust and all, to which it was reduced by distance, being carried on bullocks, and thrown down and loaded daily.

Mr. Johnstone, in a single trial of the Sonádeh coal at the mine, with an open fire, found it equal to Scotch, and without residue; and Mr. Jacob states it to have no sulphur, and little ash. Sir R. Hamilton had previously sent a

quantity to Bombay that had been excavated by Mr. Conybeare at Sonádeh; it was tried in the Steam Factory, and gave the following result:—

| | Best English Government Coal per Horse-power. | Nerbudda Coal; Average of two Trials. |
|---|---|---|
| Time in getting up steam .. .. | 38 minutes. | 37½ minutes. |
| Consumption in that time .. .. | 82 lbs. | 72 lbs. |
| Time in evaporating 33 gallons of water . .. .. .. | 30 minutes. | 30 minutes. |
| Quantity used in ditto .. .. | 23 lbs. | 28 lbs. |
| Residue below bars .. .. .. | 18 lbs. | 11 lbs. |

Captain Lynch, who conducted the experiment, reports that it got up steam quick, burned clear, left little clinker, and not more than a fair proportion of ash; that it was scarcely inferior to the best coal Government used, and was very good for general steam purposes. A third trial was made by Lieutenant Grounds, in the *Medusa*, which resulted as favourably when sifted:—

| | Nerbudda, Sifted. | English. | Nerbudda, Unsifted. |
|---|---|---|---|
| Time in getting up steam .. .. | 71 minutes. | 85 minutes. | 62 minutes. |
| Absolute consumption of wood and coal. | 56 lbs. wood. | 56 lbs. wood. | 56 lbs. wood. |
| | 336 lbs. coal. | 301 lbs. coal. | 360 lbs. coal. |
| Consumption per horse-power for 7 hours' steaming, with pressure of 4 lbs. .. .. .. .. | 7.60 lbs. | 7.85 lbs. | 9.20 lbs. |
| Ash clinker per lb. of coal .. | 0.210 | 0.204 | 0.434 |

The great defect in reference to the Nerbudda coal is, that with such excellence in the mineral itself, and such reputed advantages for mining, the information regarding the amount available for an extended supply should be so bare. Beyond the assurance that the coal is to be found in several places,—that it is close to the surface, and of good quality,—there is literally nothing upon which a miner or capitalist would act, or that would justify him in commencing operations. As competition, after all, is the climax to which all computations have reference, as well as the incentive to enterprise, and it is with the English market and companies that India has to do, the data, to satisfy them, ought to be tangible and close, and the information minute and precise,—the great desideratum being to render Bombay independent of England in respect to coal, both in point of time, cost, and quantity. Under existing circumstances,—with the Nerbudda closed to navigation, except for three months of the year, and with trunk roads few,—the transport of coal to Bombay is not to be thought of by the latter; it is a six weeks' journey, and the cost about Rs. 80 per ton on bullocks. By the imperfect and unsafe route of the river in the monsoon, Sir R. Hamilton computes that it could be carried from Sonádeh to Tullukwara for Rs. 20 per ton: but the loss by swamping of

boats, which equalled one-third, has been left out of calculation; also the cost of mining, estimated at the unprecedented rate of 9 annas per ton; likewise the conveyance from Tullukwara to Broach and Bombay, computed to be 10 annas per maund, or Rs. 17 per ton, independent of the risk and injury to the coal from exposure, wet, frequent portage, pulverization, &c. &c. To the railroad, therefore, and to it alone, can expectation be directed; and even with the expedition and cheapness that attends its establishment, it involves an extremely nice calculation whether the Presidency market, where the chief source of expenditure of Bombay is centred, can be rendered independent of England at the same prices. The consumption of coal at present, though affording no criterion for the future, is about 3,500 tons per month, as detailed below, costing, exclusive of waste, from Rs. 16 to Rs. 26 per ton, which is equivalent to about Rs. 10,00,000 per annum:—

| | | |
|---|---|---|
| Great Indian Peninsula Railway Company ..... | 80 | tons monthly. |
| Peninsular and Oriental Steam Navigation Company. | 1,100 | „ |
| Government ..... | 1,200 | „ |
| Bombay Steam Navigation Company ..... | 300 | „ |
| Total.. | 2,680 | „ |
| Mint, and other factories ..... | 100 | „ |
| Small steamers ..... | 120 | „ |
| Out-depôts ..... | 600 | „ |
| Total.. | 3,500 | tons monthly. |

By the Great Indian Peninsula Railway line, Mr. Berkley makes the distance from Bombay to Sewnee (thirty miles from the nearest coal-fields on the Towah) 438 miles; to Garrilwara (ten miles from the richest Benár or Mowpáni) 532 miles; average 485 miles. Now it may be assumed that the very lowest *remunerative* rate at which a railway could afford *at first* to carry coal, or any merchandize for long distances, would be 1*d.* per ton per mile. Some English and American lines do it for ½*d.*, and even ¼*d.*, but scarcely at the first outset, as it is a charge which none but a highly prosperous company can endure, except for particular and local purposes, and short distances, since every mile of length augments the cost, by the necessity of carrying back storing carts, unless the upward traffic is extensive. The Great Indian Peninsula Railway (and also the Baroda Railway) mileage rates are put down at 2*d.* per ton per mile; but the Bengal Railway, having a strong river competition to contend with, have already reduced their charges to 3 annas per maund, or Rs. 5 per ton from the Burdwan coal-fields to Calcutta, 120 miles, that is 1*d.* per ton per mile; at that figure conveying 300 tons daily: the Bombay estimate would be about 150 tons.

This item alone, therefore, at the above computation of distance, and the lower rate of 1*d.*, at once fixes the high figure of Rs. 20 per ton for the coal landed in Bombay, irrespective of the cost of raising it at the mine, which Sir

R. Hamilton states to be 9 annas per ton,—a proportion which has no relation to that of any English mine, which is at the lowest from 3*s.* to 5*s.* per ton. Eventually, doubtless, the mileage rate will be reduced to the lowest figure at which it is possible for the railway to work; and it will be more than something gained to feel that India can be independent of wars, and the fluctuation in freight which the discoveries and openings of other countries impose on her. Some years ago—and not in a season of pressure—Mr. Crawford, the Accountant General, calculated the cost of English coal to Government at 15 annas per maund,—about Rs. 25–4–0 per ton; which will probably be found to be little above the average, when all sources of loss and damage are taken into consideration. By no other means than the railroad can the coal of India ever be brought within this sum; for with every latitude and allowance for the difficulties of the Nerbudda, the expense of river carriage is about Rs. 37 per ton, exclusive of the great proportional losses of time, uncertainty, and the establishment of depôts, which there seems no reasonable method of lessening.

The principal causes of the low price of English coal in India are the cheapness of delivery at the mouth-pits, and of the freight out, which used to be compensated to shippers by the freight home. In the first of these, the Nerbudda coal is computed to have the advantage; in the second the reverse, as just shown. Unless unforeseen causes (which are not legitimate, because speculative grounds for rational conclusions) should occur to raise freights, and obstruct trade, it will be dubious whether the Presidency at least can for some years be rendered altogether independent of England. Sir R. Hamilton estimates that at the Sonádeh pits 35 tons per day could be raised at each shaft, or 10,920 per annum, on 313 working days; four or five shafts in full work would therefore be necessary to meet the present necessities of the Presidency alone. But this scarcely lessens the immense importance that the coal-fields open out to the railway itself, as a great impulse must be given to trade by the employment of capital, even on a limited scale. The extension of the rail also, northward and westward from the Nerbudda, to which coal would otherwise have to be conveyed from Bombay, will call for a large consumption for all the branch lines at any distance not exceeding 200 miles from the Presidency. The presence of coal will likewise enable mills for the sawing of wood to be set up; also machinery for working and draining mines; and not least, will supply the great and urgent want felt in all other parts of India, wherever iron is found, viz. fuel for smelting the ore close to the mines, and in abundance. This has been one of the great obstacles to the Porto. Novo works, and compelled the erection of saw-mills at the Baipore foundries; and it is in this peculiarity, and that of the approximation of fire-clay for furnaces, and flux for the mineral, that the chief and peculiar value of the Nerbudda Valley lies.

To exhibit the essential advantages, and almost indispensable necessity for the establishment, on scientific principles, of these resources, Colonel Kennedy gives a statistical account, affirming that the difference of cost on his line would be nearly £3,000 per mile, viz. £4,000 for Native against £7,041

for English material; all things taken together, a certain saving by Indian iron of £1,500 per mile. Leaving out of calculation the application of iron more largely in all public undertakings, as in bridges, piles, and other structures attainable to Indian iron, the superiority of Native local iron consists in the saving of freight from England, and in the mining operations; the quality of the iron, the proximity and abundance of flux, fuel, and cheap labour, affording most favourable and unquestionable conditions. Mr. Berkley states that the cost for a single line of permanent way varies from £2,810 to £3,160 per mile, half of the mileage of each section arising chiefly from the high prices of English iron material, and the great expense of conveying it from the port to the interior of the country; and this points to the great advantage of expediting the establishment of Native ironworks, which on the Nerbudda are enhanced by the valuable character of the iron; and though the axiom of Mr. Berkley in the 67th paragraph of his Report is most assuredly true, that their utility must depend primarily on the means of transport, yet doubtless very much can be effected by promptness and energy, as tons of chairs, spikes, and even rails, may be in readiness long before a locomotive reaches the Valley of the Nerbudda. The amount of iron through the whole of Central India is scarcely known, and has never been attempted to be ascertained or fixed. For ages it has been worked in the Nerbudda Valley, at Kautkot, Chandgur, Bauglee, Tendukheira, and further down at Baug, and twenty different places in the Jubbulpore district, for local consumption. This has been done in the most rude way, with little providential attention to the product, which is pretty much the same all over India; and it may be assumed that the ore is naturally rich, easily extracted, and the fuel employed good,—three of the most material points needed elsewhere. However, the cost of transport and want of skill and appliances have interfered with its price, and with the demand; and English iron and steel, both wrought and cast, in convenient shapes and sizes, beats it out of the market. Mr. Jacob, of the Baroda Railway Company's establishment, has recently entered more fully into the statistics of the Nerbudda iron, and has reported other fields at Ponassa and Makeraban. He seems to have visited those already named, and considers them rich to a degree. At Kautkot, in Holkar's territories, on the north bank of the Nerbudda, the variety is that of brown ironstone hydrated peroxide, yielding to the dry process 37.22 per cent., which ought by theory to be more. It is worked unfavourably, without flux, and silica being abundant, absorbs one-third nearly of the metal. The yield by the Native method is one-fifth, and 80 per cent. of loss, the charcoal being in the proportion of 4 to 1. With better appliances, this might be reduced one-half. The price of iron ore is 4*s.* 6*d.* per ton; of charcoal 9*s.* 6*d.* per ton; when worked £6 16*s.* 11*d.* At Chandgur the iron is reported to be red hematite, a still richer ore, which occurs in holes from six inches to ten feet deep, but friable, owing to the disintegration of metalliferous rock below. It is easily dug, and the veins exposed, every stream bringing down quantities. The Nerbudda cuts

four veins, 122 feet broad, which are perpendicular to the bank. At Tendukheira it is also a red hematite; at Penaghur, near Jubbulpore, micaceous and specular, and consequently rich; at Burwye very silicious, and poor. At Ponassa, two miles west of the town, iron is described as loose, and to be collected on the surface at the rate of 1*s.* 3*d.* per ton, and associated with dolomite, a bed of which, four miles in extent, exists. No shafts or pumps would, it is said, be required for working the mines, which could be drained by adits. The dolomite is a short distance from the coal-fields, and good water abundant. At Baug, the ore has more the character of the clay iron ore of the coal-measures, which (conjecturally) all the iron of the valley might be supposed to be, but for the volcanic agency and its greater richness. Coal cannot be far off at Baug, from the carbonaceous colouring of the sandstone, and presence of ironstone and indurated clay around. The Baug ore yields by quantitative analysis, according to Dr. Giraud, 40 per cent. of ore,—about the per-centage of clay iron ore; it is very argillaceous.

It can scarcely be denied that these estimates, rough though they be, furnish ample grounds to justify a commencement at least; and if the value of iron depends on the richness of ore, facility of extraction, and the existence of eligible adjuvants, no more favourable conditions could surely exist. Want of transport is the only impediment which may retard for a time the availability of the product; but as soon as the most recent improvements and machinery, which cheapen and expedite iron-working, are capable of being introduced,—such as Mr. Neison's hot blast, which reduces the consumption of fuel nearly one-fourth; the economizing of waste gases on the continental plan; the American process of pulverizing the ore and charcoal, rapidly deoxydizing the former; and the application of electricity to iron while hot, enabling it to imbibe carbon, and converting it by the shortest process into cast-iron or steel; Nasmyth's hammer, &c.,—the full capabilities of the Nerbudda Valley in this particular mineral will be appreciated. It is argued that the ore is too pure; that, as in the Porto Novo mines, it will, in the absence of complicated machinery, either be more advantageous to send it to England, or too expensive to cast it; but it is forgotten that the purest wrought-iron is as much needed for rails as cast-iron, and that it may be run into any shape by very simple and inexpensive means; and also that for cast-iron, poorer or inferior kinds are absolutely requisite, and are named and specified by scientific engineers to ironmasters—chairs and girders having their known proportions of pure and inferior metal. By the Native method in Central India, the ore is never roasted or pounded: they use pure and dense charcoal, sometimes in equal proportions, oftener at 3 and 4 to 1 of iron, the former placed on the hearth of the furnace, which, being small and limited, and the blast constant and forcible through it, the iron, and a great part of the slag, run out together in from ten to twelve hours, and the latter, being soluble in much less heat, spurts out in hammering, and is got rid of; the metal imbibing little of the Carbon. Were the process which is adopted in other parts of Central India,

of pulverizing the metal and coal used, and placing it in layers or balls, and inferior iron selected, the ore would, in having to pass down through layers of several feet, take sufficient carbon for any purpose, without any expensive machinery at all. For coal a quicker and more powerful blast is of course required than for charcoal; but even if portable land-engines of from 10 to 20 horse-power could be applied or transported, water-power is so plentiful as to suit most purposes, at least until weighty machinery can be brought to bear. In short, very little reasoning need be adduced to show that with the metal computed at 1*s.* 3*d.* a ton, a non-sulphureous coal at 9 annas, or even ten times that, flux and fire-clay at hand, and fuel not twenty miles distant from any mine, an ore rich enough to dispense with roasting, and a loss of about 80 per cent., every inducement exists to railway companies to explore carefully both the coal-fields and iron mines, and to bring them speedily into operation.

Regarding the subject in its broad light,—the improvement of the country by employment of capital, and the impulse to industry that will be generated; and setting aside the commercial success and profit that is anticipated,—there is abundant reason to concur with Mr. Berkley, that no statistics could present a correct estimate of the traffic that would be created if the Nerbudda Valley possessed a communication with the ports of Kutch and Bombay.

As an instance of the creation of it, by the opening of trunk roads, that of the Kilner Ghat may be named, the tolls of which in ten years, that is since its opening in 1845, have been multiplied ten-fold, from Rs. 6,000 to Rs. 60,000. By similar means, brought into operation through Nimar, under the management of Sir R. Hamilton and Captains Evans and Keatinge, the trade of one line of road in that province, the growth of five years, amounts to 12,000 tons, and 26,000 passengers. On the Kilner Ghat Road, the traffic is nearly 100,000 passengers in a year, 25,000 laden cattle, and 18,000 carts. Considering that fifteen years ago the imports and exports of Nimar were known to be Rs. 5,60,000, and the transit merchandize north and south Rs. 2,95,200, excluding, however, the opium for China, and piece goods to Central India, and that the Saugor and Nerbudda Territories at the same period yielded transit dues Rs. 70,00,000, in imports and exports Rs. 5,50,000, and in duty Rs. 3,16,675, of which the present trade of one district, Jubbulpore, is said to be 26,000 tons, some estimate may be formed of the attraction a railway is likely to cause and possess. That the line selected by the Great Indian Peninsula Railway Company, and adopted by Colonel Kennedy, possesses these to the full, admits of little question; and Mr. Berkley's assurance to that effect* needs little support. When, by the labours of such energetic officers, so little is left discretionary or dubious, and provisionary precepts are admitted and satisfied, expectation largely points to the rational assent of the ruling powers.

* Vide extracts from Mr. Berkley's Report, contained in a subsequent part of this Selection

# ANALYSIS

OF THE

# PAST CORRESPONDENCE OF GOVERNMENT

ON THE SUBJECT OF THE

# COAL-BEDS IN THE VICINITY OF THE NERBUDDA;

## AND OF THE PRACTICABILITY OF THE NAVIGATION OF THE RIVER.

# COAL-BEDS IN THE VICINITY OF THE NERBUDDA.

THE records submitted for publication may be beneficially summarised and detailed, each subject being pursued and connected throughout the correspondence, which opens with a letter from Major Ouseley as far back as November 1838, to Major Felix, Private Secretary to the Governor of Bombay, forwarding 206 bullock-loads of coal, which, from the Coal Committee's Report, appears to have come from the Benár fields for trial in Bombay. It was imagined to be anthracite, and taken at random from the exposed seam.

The expense (being at the rate of Rs. 80 per ton, viz. 10 bullocks at Rs. 8 each, carrying one ton) was justifiable as an experiment; but the method adopted to carry it out precludes at once, and for ever, any such system in future. On a most fair and impartial trial for two hours and a quarter in Bombay harbour, in a small Government steamer, (Glasgow coal burning in opposition,) the Nerbudda coal was found to raise steam quicker, with about half the expenditure, being as 10½ lbs. to 19¼ lbs. per horse-power: there was little ash; but the objection was, that there was a good deal of clinker on the fire-bars, accounted for by the pulverization the coal had been subjected to by the mode of conveyance.

The Bombay Government at once took up the subject, and in reporting on it to the Honorable Court, recognised the importance of the proximity and value of the Nerbudda coal; the Supreme Government was at the same time requested to authorise measures to give full effect to bring the coal into extensive use.

The Court of Directors likewise regarded the experiments with favour, and recommended further trial with Slangennach, Lewis Crown Valley, and West Hartley coal, which they consigned to India for the purpose: they however feared rather than encouraged the natural difficulties of the journey. There seems no record whether these intentions or experiments were ever carried out, though the subject was again mooted in 1841. In that year Government, on a letter from the Assistant Commissioner in the Saugor and Nerbudda Territories, addressed the Collector of Broach, requesting to know the cost of coal from Tullukwara to Bombay, which was found to be 10 annas per maund, or Rs. 17 per ton. From the report of the Accountant General, Mr. Crawford, it also appeared that English coal cost at Bombay Rs. 25-4-0 per ton, or 15 annas per maund, hamallage not included. Government, however, authorised the Assistant Commissioner in the Saugor and Nerbudda Territories to send fifty or a hundred tons of coal down the Nerbudda, experimentally.

In 1844 the Military Board, to whom reference was made, reported that they considered the important point was the means of transport; and as no coal existed in the Bombay Presidency, recommended either a railroad or the opening of river navigation, believing that where obstructions in the latter existed, they might be obviated by portage along the banks. In respect to railroads, they stated that these involved a consideration of the general traffic of the country, on which no information was before them. Dr. Giraud at this period analysed specimens of the Nerbudda coal in conjunction with some from Kalabagh, Attock, and English Cannel coal, and found it abounding in combustible hydrocarbonates, but deficient in carbon, with a large quantity of ash; which properties demonstrated it to be a good gas-producing coal.

In 1847 Sir G. Clerk, acting on a letter from Sir R. Hamilton, Resident at Indore, took up the subject again warmly, and ordered a trial of some coal from the Sonádeh field, 150 miles lower down the valley, which had been obtained by Mr. Conybeare at Sir R. Hamilton's instigation. He directed the result to be sent to Sir Robert, with a request for further information from him, likewise soliciting the opinion of Sir R. Oliver, Superintendent I. N.—Captain Lynch, I. N., who was appointed to conduct the experiment, in handing up his Report of this coal, says that it got up steam quick; burned clear, with little clinker, and not more than a fair proportion of ash; and that it was little inferior to the best Government coal, and well adapted for Government purposes. The figured statement which he forwarded showed that its heating powers were as quick as the best Government coal, the consumption being 12 per cent. less, and the residue below the bars one-third less. There may be introduced here a further trial, in 1848, by Lieutenant Grounds, I. N., who reported unfavourably of the coal, viz. that it left a large amount of clinker in proportion to English coal, showing a great quantity of incombustible material, and that it stopped draught, by being soft, and spreading over the bars. This was the coal brought down by Captain Fenwick; it gave, however, a much better result on being sifted. The Resident of Indore upon this urged a further trial, which was conceded by the Bombay Government, and Captain Lushington, Superintendent I. N., after again subjecting it to practical tests, considered the Nerbudda coal in all respects equal to the best coal usually imported for the use of Government; he conceived it a great acquisition, rendering Government independent of foreign supply. The only drawback was its great state of pulverization, which, when sifted, gave most satisfactory results, as follows:—

| Time in raising Steam. | Consumption per Hour, per Horse-power. | Ash and Clinker. |
|---|---|---|
| Min. | lbs. | |
| Nerbudda coal, sifted .. .. 70 | 7.60 | 0.210 |
| English coal .. .. .. .. 86 | 7.85 | 0.204 |

The Resident at Indore, on receipt of this, urged the propriety of excavating and working the coal, in order to avoid the chance of a short stock in Bombay. He applied for the services of a qualified miner, and obtained those of Mr. Johnstone, of the Indian Naval Department, who joined his camp on 15th January 1848, and proceeded with him to the Sonádeh fields, which were half a mile from the village of that name, on the Bohra nulla, thirty-four miles from Sewnee, with a bad pass at Nandwára, hardly practicable for carts. Mr. Johnstone subsequently hit upon a better route, avoiding this pass, which Captain Fenwick afterwards travelled over, and which it was calculated could be made practicable for Rs. 500, *viâ* Peepliah, Gowásing, and Mukrái, to Dharee, the point on the Nerbudda below the fall which it was desirable to fetch.

Sir R. Hamilton left with Mr. Johnstone full instructions to ascertain the limits, depth, and all particulars regarding the coal, and its associated iron, and directed other places to be searched. His personal observation determined him to raise 20 tons; and for this purpose he directed the sinking of an experimental shaft, for which he furnished Mr. Johnstone with means and tools, and obtained the assistance of Captain Fenwick, a retired and energetic officer of the Nizam's army.

Mr. Johnstone reported the iron equal to the black main of Scotland; the coal to be in beds of twenty inches thick, at an angle of 7½° N., between layers of shale and coarse soft sandstone, thirty feet of which were above the coal. He pronounced it, on trial on an open fire, to be equal to Scotch, as it burnt without residue,—a fact opposed to the chemical analysis of it, which gave a large amount of incombustible material. He described the limits of the basin to be fifteen by twenty miles. He also visited the Mardanpore fields, referred to by Colonel Ouseley, two miles from Bohra, in the bed of the Sookee nulla, about 100 yards from its junction with the Towah: the seam of coal here was two and a quarter feet thick, sp. gr. 1.229, at an angle of 20° in a NW. direction.

Sir R. Hamilton calculated that the coal thus obtained could be deposited at Tullukwara, three days' sail from Broach, at Rs. 20 per ton, viz:—

| | | | |
|---|---|---|---|
| Transport to Dharee from coal-fields.... | 7 | annas per maund. | |
| „ from Dharee to Hurun Pall .. | 2 | „ | „ |
| „ „ Hurun Pall to Tullukwara.. | 3 | „ | „ |
| Total.. | 12 | annas; independent of the expense of working the shafts. | |

After the shafts had been sunk, and the required quantity raised, considerable time was occupied in arrangement with the Brinjárees; with whom it was so difficult to deal, and upon whom it was so impossible to depend, that it was thought as expedient to make a rough cart-road, avoiding the Nandwára Pass, as no inducement could persuade them to do otherwise than throw off their loads, as if they were grain, which was better adapted to their bullocks than the angles of the coal. Captain Fenwick, with a great deal of tact and patience, at length induced the Brinjárees to proceed, and succeeded in transporting to

Dharee, a distance of 100 miles, 462 maunds (about 17 tons) of coal, on 226 bullocks, each bullock thus carrying 140 lbs. or 1¼ cwt., at a cost of 6½ annas per maund, or Rs. 11 per ton.

From the experience gained in sinking the shafts, an estimate was formed of the cost of one large enough for pumps. These Mr. Johnstone calculated would be Rs. 6,344 per annum for each shaft; from which 35 tons could be raised daily when fairly at work, *i. e.* 10,920 tons per annum, at a cost per ton of 9 annas and 4 pies. The shaft it was assumed would be sixty feet deep, and could be drawn with bullock-power, or a small steam-engine. The proceedings so far were reported to the Bombay Government, who most promptly acted on them. In a most able and statesmanlike minute they thanked the Resident for his exertions, recognised the importance of the subject, irrespective of the eventual result to steam, marine or railroad; they offered all the encouragement in their power, which was limited to permission for Mr. Johnstone to remain as Superintendent, and to placing Rs. 10,000 at Sir R. Hamilton's disposal, to be expended as his increasing experience might dictate; they hinted that more should not be done to roads than mere clearing. Urging economy, they proposed that search should be made for other coal-beds nearer the river, and as there was no immediate want of coal in Bombay, recommended magazines to be formed at different spots on the Nerbudda, and the coal to be floated down to each, as time and conditions would admit; they suggested to the Resident's consideration the subject of leasing the soil, and the right of working the mines, and asked for information on the tolls and customs on the banks of the river, and in transit.

The Resident, in his reply, furnishes an estimate of the proposed shafts, which he divided into three departments :—

| | | |
|---|---|---|
| One of superintendence, at..... | Rs. 700 | monthly. |
| One of transport, at ..... | 300 | „ |
| One of establishment for shafts, at ..... | 532 | „ |
| Total.. | Rs. 1,522 | monthly; |

the latter comprising miners, carpenters, bullocks, and drivers, &c., which only it would be requisite to increase with each shaft. Thirty-five tons per working day was still adhered to as the quantity that would be raised.

The Resident further reported the arrival of the coal packed in 386 bags at Chikulda, 150 miles from Broach, on the 20th April, in fifteen days from Dharee, and requested a steamer of light draught, if unemployed, to be sent, to take in the coal at Broach. He likewise submitted Captain Fenwick's journal of the voyage down 110 miles of the river.

Government again freely responded to the call, by authorising the steam-vessel, and applying to the Honorable Court for the continuance of the services of Mr. Johnstone at the coal-fields. They desired, however, not to be committed to a year's undertaking in the existing and imperfect knowledge of the navigation of the river, and requested the Resident to feel his way. They transmitted a summary of all proceedings up to that period to the Supreme

Government, with a strong recommendation in favour of the continuance of the undertaking.

Though Captain Fenwick reached Chikulda in safety with his cargo and fleet, which consisted of ten boats, thirty feet long, six feet in breadth, and drawing two and a half feet of water, each carrying about two tons, his voyage down this 110 miles of river, accomplished in fifteen days, was not altogether without difficulty. Its general character was a rapid shallow stream, deep above, and opposite the fords with rapid descents: from six inches to two feet of water existed over these channels, which were winding and tortuous. Between Dharee and Mundlaisir he had to let the boats down with ropes in four places, and at the falls of Sahesur Dhurah they were emptied, and the coals carried overland for about 600 yards. Boats drawing above one foot of water could only be used with ease. Sahesur Dhurah was the only direct fall in this portion of the river, and had a back-water channel, which rendered it less difficult than it otherwise would have been.

Arrived at Chikulda, Captain Fenwick stored his coals in a godown attached to the bungalow at that place, and proceeded fifteen miles down the river, to examine the Hurun Pall, the next formidable pass. He found it simply a deep narrow gut or sluice, between high rocks, with eight feet channel in the middle, and no fall; it had only six inches of water in several places, and laden boats of a draught of a foot and a half, of the length and beam of his own, could not possibly pass, and even empty ones would have to be lifted. He found (what Captains Anderson and Evans had reported) that it was not at the Hurun Pall, but a quarter of mile below it, that the great obstacle existed—the Balaghori rapids. In April (the dry season) there were three falls of a hundred yards each—the first of six, the second of three, and the third of four feet in thirty; with ten feet passage in mid-channel, in which pointed rocks jutted. The force of the current was intense, with, however, a deep back-water on the left hand. Judging it, even with this outlet, impracticable for laden boats at this season, Captain Fenwick returned to Chikulda, and by orders took 1¾ tons of coal on two carts to Kumálee, below Tullukwara, which he reached in fourteen days; there he took boats again, and arrived at Broach altogether in twenty-one days from Chikulda. The précis furnished by Sir R. Hamilton of this part of the proceedings was pretty much the substance of Mr. Johnstone's Report before alluded to, together with the data furnished by Captain Fenwick.

The Sonádeh coal was found on the left bank of the Bohra nudee, at an angle of 7½° N., and associated as follows:—

| | Feet. | ins. | |
|---|---|---|---|
| Sandstone ..... | 30 | 0 | coarse-grained; soft. |
| Shale ..... | 0 | 4 | |
| Coal..... | 1 | 7 | |
| Shale ..... | 0 | 4 | repeated; the lower formation being a closer-grained sandstone. |

Captain Fenwick, with 462 maunds of coal, on 226 bullocks, it appeared—

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Left Sonádeh | on the 9th Mar., | reached | Dharee, | 100 | miles, | 25th Mar., | in 16 | days. |
| „ Dharee | 5th April, | „ | Mundlaisir, | 50 | „ | 9th April, | in 4 | „ |
| „ Mundlaisir | 10th „ | „ | Sahesur Dhurah, | 6 | „ | 14th „ | in 4 | „ |
| „ Sahesur Dhurah | 16th „ | „ | Chikulda, | 50 | „ | 20th „ | in 4 | „ |
| „ Chikulda | 27th „ | „ | Tullukwara, | 120 | „ | 10th May, | in 14 | „ |
| „ Tullukwara | 10th May, | „ | Broach, | 60 | „ | 13th „ | in 3 | „ |

Total... 45 days.

Thus the first land portion of the journey of one hundred miles occupied sixteen days, owing to the time lost in lading and unlading the bullocks. It was undertaken at a great cost, Rs. 11 per ton, with the coal much broken and injured; ten days were spent besides at Dharee, in arranging the boat-loads. The first fifty miles of river were completed in four days, and the other fifty miles in as many more; the portage at Sahesur Dhurah occupying two, and the shallow part of the river approaching it (being obstructed by rocks and rapids) four. Further progress beyond Chikulda was impossible in dry weather. Captain Fenwick consequently proceeded by land, as already stated, taking 48 maunds (1¾ tons) on two carts, *viâ* Ali Rajpore, Oódeypore, to Kumálee, and below Tullukwara, a land journey of fourteen days, at a cost of Rs. 1-7-0 per maund, which is at the rate of Rs. 38-11-0 per ton. Captain Fenwick reached Ukteysur Ghat, below Tullukwara, on his return, in six days, and Chikulda by land in twenty-eight. Sir R. Hamilton concluded by recommending depôts for the storing of coal at Dharee, Sahesur Dhurah, and Chikulda, and urged the excavation of mines.

Government in reply, while admitting the importance of the object, hesitated to adopt these measures unreservedly, and the Supreme Government, to whom the correspondence passed, deferred further operations until Dr. McLelland or Mr. Oldham could be spared to visit the localities. In a subsequent letter the Supreme Government considered the experiment expensive, and the calculations indefinite; they required fresh information, and stopped all arrangements involving expense which were not of a temporary character.

The monsoon having however set in, and the river risen eighteen feet (even then scarcely safe), Captain Fenwick left Chikulda on the 29th July with 400 maunds (15 tons) of coal, in 239 bags, stowed in eight boats, especially built or selected for the purpose. His arrangements seem to have been most prudent, cautious, and excellent. He accomplished the distance from the Hurun Pall to Mokree, eighty miles, in twelve days, the river having high banks, hills, and jungle flanking it on both sides to the water's edge. In this distance he lost three boats and 93 maunds of coal; he met with twelve most serious obstacles, in the shape of rapids, whirlpools, shoals, and pointed rocks, which latter it was impossible to avoid, owing to the force of the current. The Hurun Pall was reached and passed without difficulty: next day (at one mile below it) the Bhorekeyree rapids appeared, now converted into one, five miles in length, with thirty feet channel, not well defined, and studded with

bluff rocks, having high waves, and a rapid current, owing to the direct fall, One boat was here lost, with 38 maunds of coal. Two miles further was the Gunoee Ghat, the features of which agreed precisely with Captain Evans's Report of them in the Transactions of the Geographical Society; at a similar distance further on, the Kalukeyree ledge of rock, and the Dussána barrier, of the same nature, were successively met. On the 31st, at twenty miles, the Bheetána Ghat rapid (bad for half a mile, and also very much resembling the Sahesur Dhurah) occurred. It was two miles and a half long, the river shallow, with high cliffs striking diagonally across—the left one formidable; and half a mile below it, as usual, was the rapid. The boats were let down by ropes, and 150 bags taken out and carried. Two miles further, the Hailkuree gut was met, succeeded by the Sirkuree shoal, leading to Nunka Ghat, one of the worst in the river. On the fifth day, Captain Fenwick reached Hamp, six miles further, and forty from Chikulda. This was a notable obstacle traditionally, but Captain Evans had already demonstrated that the real danger existed in the Balaghori rapid, a few miles down the river. This is described as being three or four miles in length,—in fact a series of descents, studded with broken rocks for that distance; and the very natural results of such, when large volumes of water of great velocity rush along between scarped, confined banks, viz. whirlpools, high waves, an unmanageable stream, and the utmost danger: two boats with 66 maunds (2½ tons) of coal were lost here. From the termination of this to Soolpan (fifteen miles), the river was found tolerably clear. About six miles below Soolpan the Mokree falls occurred, in three days' work from Hamp, in which difficulties of the same nature presented themselves, which were *shot* by Captain Evans, the water being higher, but in which one boat was lost by Captain Fenwick. Here the hills and jungle ceased, and cultivation began. From this to Tullukwara, thence to Broach (reached in twelve days), no material impediments occurred. Between the last-named places navigation is clear and quick up to November, and this lower portion was compared by Captain Fenwick to the Bagheeruttee or Hooghly between Berhampore and Calcutta at this season. In order to ascertain the practicability of returning to Chikulda by water, Captain Fenwick, after great trouble with the boatmen, started for Tullukwara on the 14th August, and reached the former place on the 26th September, in forty-three days; but his journal affords little information, further than that the river was impracticable against stream, of which the length of time alone is sufficient evidence.

Captain Fenwick believed there was not, on a stretch, a mile of free navigation between the Hurun Pall and Mokree; his cargo was exposed to constant showers, wet, and spray from high waves, which would have been destructive to valuable articles,—against which there is little hope of provision or improvement as regards boats, which require to be of a peculiar construction, and of exceedingly light draught; even the coal was pulverized, wet, and lost much of its essential qualities. Of his whole cargo of 462 maunds (17 tons),

nearly 100 maunds were lost by the swamping of boats; 48 maunds were taken overland, and the rest, 11 tons 10 cwt., landed at Broach.

Sir R. Hamilton, in reporting this, conceives that though difficulties in these eighty miles might be facilitated by science and skill, and the removal of some obstructions, the foregoing details, the close and hilly nature of the country, and the jungle fever prevalent after 15th September, render the river unnavigable for purposes of commerce. Captain Fenwick himself, owing to the fatigue and exposure, was nearly carried off in Bombay from consequent severe remittent fever.

The most that could be concluded of the Nerbudda from Captain Fenwick's proceedings was that it might be passed between August and December, but not between February and June; and it is evident it must, at best, depend on the rise of the river, and the quantity of water, as Captain Fenwick's obstructions at the same spots were more serious than Captain Evans's when the river was full. This applies likewise to the level portion beyond Tullukwara, in which, after September, the journey is more tedious, and several rapids are exposed by the cessation of the rains. The freshes have also to be watched: in fine, there would appear to be great uncertainty, as well as extreme difficulty. Captain Fenwick's trip is perhaps more confirmatory of Sir R. Hamilton's first conclusions in respect to Captain Evans's voyage. Sir R. Hamilton says:—

"As to the means for making the Nerbudda available to commerce, I have great doubts whether the returns would compensate for the outlay. The formation of roadways to transport the freight of boats at the different falls may be undertaken; but they alone will not suffice: there must be a line of boats to carry on the goods which may be sent, and an unity of working, which only could be secured by a river company, or by a Government establishment."

The expense incurred cannot be considered a criterion for the future; for in all undertakings, experiments and first operations are necessarily large, and not thrown away or costly in the main, if they lead to the exposure, removal, or remedy of defects, whether these relate to the enhancing of the value of the products, the reduction of cost of conveyance by improvement of roads, or otherwise. A perusal of these experiments in contrast with Mr. Berkley's and Colonel Kennedy's Reports will certainly incline the present generation of thinkers and readers to the opinion that the 500 miles of distance interposed between the sea and the Nerbudda Valley (proper) may be more expeditiously, more safely and permanently, also more advantageously and less expensively overcome by rail, than by the most approved system of river navigation that could be contemplated.

The papers which follow are not of less importance than those on the navigation of the Nerbudda. They are the Reports of Mr. Jacob on the Mineral Resources of the Valley, and of Mr. Berkley and Colonel Kennedy on the Rail. In accordance with his instructions, the first proceeded to the iron mines of Kautkot, Chandgur, Tendukheira, Ponassa, and Makeraban. They are all

hematites, viz. hydrated peroxides of iron, ochreous, superficial, and very rich in ore, which they yield pure at a loss of about 80 per cent. by the Native method of extraction, with charcoal fuel, and no flux, or previous roasting. The present prices are 4*s.* 6*d.* per ton for ore, and 9*s.* 6*d.* for charcoal at Kautkot, and which may be had for 5*s.* 6*d.* at Tendukheira. Coal is, however, within reach, and not many miles distant, for 9 annas, and iron quite good enough for casting at 1*s.* 3*d.* per ton at Makeraban, on the Towah. At Burwye the ore was friable and silicious, but exceedingly pure at Chandgur, Kautkot, and Tendukheira : at the former, the Nerbudda cuts through a large vein, and every stream brings down quantities. At Ponassa, a good flux (dolomite), and fire-clay, are found seventeen miles from the coal, which it was estimated may be had for 4 annas per ton ; and also surface iron of quality adapted for casting. Mr. Jacob recommends it therefore as the site of their mines, which would require neither shafts nor pumps, and he calculates they may be worked under £5 per ton for ore.

The coal seams at Sonádeh Mr. Jacob thinks indicate rich mines below Their general extent is probably fifteen by seven miles. The Benar field, on the Seeta Rewa river, has three seams—of eight feet, three feet six inches, and six feet three inches ; separated by laminated shale, four inches thick ; the available seam being nine feet nine inches,—highly inclined, owing to trachyte veins. He characterises it as a bituminous lignite, with no sulphur, well adapted for iron-smelting, and little residue. At Beethári Ghat, the Nerbudda cuts a pyritous coal seam at an angle of 80°, overlaid by dolomite. The result of this geological report, necessarily cursory and superficial, denotes an inexhaustible supply of iron, with all the incidental advantages of flux and fuel in close proximity, cheap, and easy of access.

Next in succession are the Reports of Colonel Kennedy and Mr. Berkley on the Line of Rail through the Nerbudda Valley. Colonel Kennedy, on finding the Great Indian Peninsula Railway Company already in the field, seems to have adopted the general direction of their line, the excellence and selection of which is undisputed : the features of the country really do not admit of two distinct routes. The contemplated line, Mr. Berkley says, after crossing the Taptee, ascends the Satpoora range, the summit of which is only 390 feet above the level of the river, by a series of easy reverse curves. Its ascent is effected in a distance of twelve miles, without any work that calls for observation, and with various gradients, the worst of which is 1 in 100, of a length of a mile and three quarters, and descends by still lighter. They are more favourable than Mr. Berkley expected it was possible to obtain. The Nerbudda is crossed at Jhansee Ghat, about 500 miles from the mouth of the river, with a viaduct of 371 yards only, without any engineering difficulties, or expensive contingencies ; and between these extreme points, viz. Asseerghur and the Nerbudda, the course of the railroad runs through the essentially productive part of the valley, or upper basin of the Nerbudda, passing in the immediate neighbourhood of the large towns, and the iron and coal mines, the

importance of which may be truly said not to be over-estimated, if it is called to remembrance that the permanent way of the rail, some 450 miles in length, has to be obtained from England, at a cost of at least £3,000 per mile (the high prices of which Mr. Berkley, at paragraph 67, states is the serious and undue impediment to the cheap construction of railways through the interior of India), and that the several demands for coal in Bombay come to nearly 50,000 tons per annum, which is imported from England, at a cost of at least ten lakhs of rupees. Through the entire line, the requisite material for earth-works, stone and lime for building, teak of large scantling, and other good woods, abound, and are procurable at short distances, and can be conveyed down the Nerbudda and tributary streams. Were it not for the river crossings, Mr. Berkley affirms the cost of this portion of the railway would reach the very lowest limit, the curves and gradients being particularly level and straight, the labour low, and engineering difficulties few. In short, the character of it is unexceptionable, and presents the utmost facility for construction. Mr. Berkley's Report, in these and all other respects, is so ably drawn up, and is so clear and intelligible a narration of not only the immediately professional view of the undertaking, but of the commercial and industrial value of opening this line (so far as his statistics enable a decision to be arrived at), that the short reference to his conclusions does but little justice to his summary, which is worth attentive study. It but renders patent the very pertinent remark of the *Friend of India* on railroads in the interior, "that the country, which is now nearly closed, the resources which are now sealed, and the intercourse which is now nearly buried, would all be benefitted, to the manifest advantage of Government and of commerce, as well as of social happiness and comfort," by their speedy sanction and completion.

For similar reasons, limiting the observations on Colonel Kennedy's Report to that portion of it which has reference to the object of these papers, the resources of the Nerbudda Valley, it would seem that the Colonel's primary object is to open a communication from the Khandeish branch of his central line to the iron and coal-fields of the Nerbudda,—which he considers it indispensable and essential to work at once,—to establish foundries, sink shafts, and make it available for the large and extensive branches which his project embraces. Convinced from Mr. Jacob's Report of the nature and amount of the resources, Colonel Kennedy expects to effect a saving of £1,500 per mile on his lines of rail; and to carry the principle further, he recommends to Government the substitution of iron bridges, pile piers, and other improvements on iron structure, which may be placed within attainment, to the exclusion of the more expensive masonry viaducts and bridges contemplated. He would import iron for the first 100 miles from England, and make an iron way from his foundry at Ponassa to his junction. Although, as Colonel Kennedy states, it is impossible to overrate the beneficial consequences that the Nerbudda mineral districts are calculated to produce in the industrial development of India, if properly dealt with, yet, considering that Surat, the nearest point to

his direct line, is a distance of 250 miles from the nearest foundry, and that a line of some nature, whether of tram and temporary character, or of permanent way, must be completed, before a ton of machinery could be carried up, or of iron be brought along it, there would seem better grounds for concurrence in Mr. Berkley's reasoning, "that active and successful operations in these enterprises will be found to depend more upon the completion of railway communication between Bombay and the Nerbudda Valley than the railway does upon a local supply of iron and coal." Bearing in mind the immense extent of the contemplated railroads to the north of the Nerbudda (and through Malwa more directly still to the north), there is little fear that the most ample occupation will be found for all the coal that can be raised, and iron made, for the next century, after the completion of the line to the Nerbudda Valley. If iron and coal are the chief aim of Colonel Kennedy in entering into the Nerbudda Valley, he is likely to meet them much closer at hand at Baug, which is scarcely thirty miles from Rajpore, a point on the north bank of the Nerbudda on his Baroda and Culpee extension line; and it is questionable (and here thrown out as a surmise, irrespective of engineering reasons and difficulties) whether the Nerbudda Valley and Colonel Kennedy's own central line would not be more benefitted by taking one to the coveted and desirable mines at Ponassa, along the north bank of the Nerbudda, from Oodeypore or Rajpore through British Nimar, than from Surat *viâ* Khandeish. Of one fact there is little assurance required—that one line, whether to the Nerbudda Valley, proceeding over the Deccan ranges, or skirting them *viâ* Surat, will not suffice to supply the wants of traffic that will be generated; and that the line sketched out *viâ* Bhopawur, Indore, and Bhilsa to Culpee, will be of equal if not greater value, and not even in imagination less important than that of the Taptee and Nerbudda Valley, drawing, as it must, the rich opium and grain districts of Malwa, and the upper portions of the Saugor and Nerbudda Territories, which are above the Ghats. There certainly exist grounds for the belief that most ample and remunerative returns will be obtained by the speedy opening and connection of Western India with the North-Western Provinces, through the unoccupied and fertile districts of Malwa and Rajpootana, which, though not as rich in cotton, are as favoured in other respects as any parts of Khandeish. It would be matter of surprise if the Governor General of India, himself the best authority and soundest thinker on these topics, should limit the operations of both companies to the same districts, or permit them to run in close contact and competition, while so vast a territory and line of country remains unoccupied, and invites their labours.

SELECTION FROM THE RECORDS OF THE BOMBAY GOVERNMENT,
1838–1851,

RELATING TO

# THE NERBUDDA RIVER,

AND THE

# MINERAL DISTRICTS OF THE NERBUDDA VALLEY;

TO WHICH ARE APPENDED,

EXTRACTS FROM REPORTS BY MR. J. J. BERKLEY, CHIEF RESIDENT ENGINEER, BOMBAY, OF THE GREAT INDIAN PENINSULA RAILWAY COMPANY; AND BY LIEUTENANT COLONEL J. P. KENNEDY, MANAGING DIRECTOR AND ENGINEER-IN-CHIEF, OF THE BOMBAY, BARODA, AND CENTRAL INDIA RAILWAY COMPANY; WITH ACCOMPANIMENTS TO THE LATTER REPORT.

# NERBUDDA RIVER,

AND THE

# MINERAL RESOURCES OF THE NERBUDDA VALLEY.

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From Major J. R. Ouseley, Pol. Agent and Commr., Hooshungabad,
To Major Felix, Priv. Secy. to the Hon. James Farish, Governor of Bombay.

*Dated the 27th November* 1838.

Sir,

As required in your letter dated 14th September last, I have the honour to send 200 Bunjaras' bullocks, laden with coal. About 10 tons are carried on 100 bullocks. Great difficulty is just now experienced in getting Bunjaras to go in that direction at all; and the only terms they would accept were for each bullock Co.'s Rs. 8 the trip. This may occupy a month and a half; so that it is not very high after all. I have paid Rs. 800 here, and the remainder (Rs. 800) they will receive at Bombay. The experiment is expensive; but at the same time, I trust it may prove to be one that will ultimately convince Government that the value of their internal resources is as unbounded as the most sanguine could imagine, and ensuring independence of all mischances in the regular supply of fuel for the home communication by steamers. Anthracite coal has been found at home to be infinitely superior to every other kind for steam purposes: the fields of it here are literally inexhaustible. When I add that wood for charcoal, and iron ore, abound at the same spot, it may not be visionary to hope that a line of railway direct from Bombay to Mirzapore, *viâ* Boorhanpoor, may, in the course of a few years, be determined on: the advantages are as incalculable as they are obvious; Mirzapoor and Bombay at each terminus of the line could then be supplied to any amount, and for little expense.

I have desired the Bunjaras to be particularly careful to avoid flinging down the loads, as they do grain; for it would soon reduce all the coal to powder. I have the honour to send a bit of the coal, taken at random from one of the loads, as a specimen: it evidently improves the deeper it is dug into.

I have, &c.

(Signed) J. R. Ouseley, Major,
Political Agent.

*Hooshungabad, Office P. A. and C., the 27th November* 1838.

To the MINT ENGINEER.

SIR,

I am directed by the Honorable the Governor in Council to request that you will receive charge of a quantity of coal sent by Major Ouseley from Hooshungabad, and that you will subject it to all the tests that may be best calculated to ascertain its quality and adaptation for the service, and report the result for the information of Government.

I have, &c.

(Signed) E. M. WOOD, Lieutenant Colonel,

*24th January* 1839. Secretary to Government.

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From Captain H. B. TURNER, Mint Engineer, Bombay,

To Lieut. Col. E. M. WOOD, Secy. to Govt., Marine Dept., Bombay.

*Dated the 12th June* 1839.

SIR,

I have the honour to report, for the information of Government, the result of a trial made yesterday of the *Indus*, iron boat, with a view of ascertaining her speed, and the performance of her engines; and, in compliance with the instructions conveyed in your letter of the 24th January last, of proving the comparative value, as a fuel for steam-boat engines, of the coal obtained from Major Ouseley, at Hooshungabad.

The vessel was sent out in pieces from Mr. John Laird's factory, and the engines supplied by Mr. Maudsley; they are of 60 collective horse-power, having 32-inch cylinders, 3-feet stroke, with wheels of 14 feet 6 inches diameter.

The vessel had on board 28 tons of coal, being sufficient fuel for four days of twenty-four hours each; her draft of water abaft was 3 feet 6 inches; and although the marks on her stem showed a greater draft forward, I am disposed to believe she was on an even keel.

We started from opposite the southern buoy of the middle ground at 10h. 30m. A. M., being a few minutes before high-water, and stood up the harbour in the direction of Tanna, the engines making 26 revolutions. We reached Chenanee bunder, about one mile below Tanna, and 22 miles from the point from which we started, at 12h. 40m., having gone at the rate of 10.15 miles per hour. At first starting, the tide, though slack, was in our favour; but after rounding the point of the Neat's Tongue it turned, and, if anything, was against us the rest of the way; deducting, therefore, half a mile an hour for the tide, it leaves her speed through the water 9.65 miles per hour.

On arriving off Chenanee, the engines were stopped for a few minutes to screw down the packings, and to fix the indicator, and again started towards Bombay at 1 P. M. At 3 P. M. we reached the point we had started from, having had a strong tide in our favour; but the wind and swell, which had much increased since we started, were directly against us,—sufficient, indeed, after leaving Trombay, to reduce the speed of the engines two revolutions.

The vessel is fitted with two boilers, also made by Mr. Maudsley, of precisely equal capacity, and perfectly independent of each other, having one fire-place in each. The same quantity of water was filled into each boiler, and the fire-place of the one laid with good fresh Glasgow coal, and of the other with Hooshungabad coal.

Steam was up, or commenced escaping at the safety-valve in the boiler, with the Hooshungabad coal, in 1 hour 30 minutes after lighting the fires; the quantity of coal expended, including what was used in laying the fire, being 2 cwt. 3 qrs. 8 lbs., or 10.53 lbs. per horse-power.

In the boiler with the Glasgow coal,—the fires having been lighted in both at the same time,—the steam was not up till 15 minutes after it commenced blowing off in the other boiler, and the quantity of coal expended was 5 cwt. 20 lbs., or 19.33 lbs. per horse-power; thus showing the Hooshungabad coal 83 per cent. better than the Glasgow, and raising the steam in 15 minutes less time.

From Bombay to Tanna I continued to use the Glasgow coal in one boiler, and the Hooshungabad in the other, keeping the steam up in both to the same degree of elasticity: in the 2 hours and 10 minutes, 6 cwt. 1 qr. 18 lbs. of the Glasgow coal was expended, being equal to 11 cwt. and 4 lbs. per horse-power per hour; while 5 cwt. 1 qr. 10 lbs. only of the Hooshungabad coal was used, being 9.20 lbs. per horse-power per hour.

In returning to Bombay, for the first hour, while in smooth water in the river, the engines making 26½ revolutions, Hooshungabad coal was used in both boilers, and 6 cwt. 27 lbs., or 11.65 lbs. per horse-power, was consumed.

During the next hour, both boilers were fed with Glasgow coal; and notwithstanding the speed of the engines, and consequently the quantity of steam required, was reduced, as before stated, by the strong head wind, 7 cwt. 1 qr. and 6 lbs. was expended, being at the rate of 13.96 lbs. per horse-power.

The expenditure of coal in both cases per horse-power will be considered large: but it must be taken into consideration that the engines are of small size; that neither the boiler, steam-chest, nor steam-pipe have as yet been covered with any non-conducting substance; and that from their being quite new, and a good deal rusted on the voyage out, the surfaces have not yet become steam-tight.

The Hooshungabad coal produces very little ash, but, like the Burdwan coal, forms a good deal of scoria or clinker on the fire-bars.

It ought also to be remarked, that from the distance this coal has been brought overland (500 miles), it has been broken into very small pieces,—indeed a good deal of it is literally dust: in using it, however, the dust was not separated, the expenditure above shown being the exact weight of the coal expended, dust and all.

I have, &c.

(Signed) H. B. Turner,

*Bombay, Mint Engineer's Office, 12th June* 1839. Mint Engineer.

From the GOVERNMENT OF BOMBAY,

To the Honorable the COURT OF DIRECTORS FOR AFFAIRS OF THE HONORABLE EAST INDIA COMPANY, London.

*Dated Bombay, 10th July* 1839.

HONORABLE SIRS,

We have the honour to transmit the accompanying copy of a letter from the Mint Engineer, dated 12th ultimo, reporting upon the performance of the new iron steam-boat, the *Indus*, and also on the quality of some coal which we lately procured from Hooshungabad.

The performance of the *Indus* appears to us to be most satisfactory; but the most interesting part of the Report relates to the Hooshungabad coal, which is stated to have got up the steam with about half the quantity of fuel, and in less time than with Scotch coal.

As we have no doubt that the Right Honorable the Governor General will concur with this Government in the very great importance of measures being adopted for obtaining further supplies of the superior coal found at Hooshungabad, we have requested his Lordship to authorise such course as may, in his opinion, be best calculated to give the fullest effect to the measure of bringing this coal into extensive use.

We have, &c.

(Signed) JAMES FARISH,

*Bombay Castle, 10th July* 1839. „ G. W. ANDERSON.

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*Reply from the Honorable the* COURT OF DIRECTORS *to the foregoing Despatch.*

*Dated 12th August* 1840.

*Letter dated 10th July, No. 36 of* 1839.

Forwarding Reports on the performance of the new iron steam-boat the *Indus*, and on the qualities of some coal, forwarded from Hooshungabad, as applicable to steam purposes.

These Reports are interesting, and in general satisfactory.

On the occasion when the Hooshungabad coal was tried as a fuel on board the *Indus* steamer, it appears that the fire-place of one of the boilers was laid with good fresh Glasgow coal, and that of the other with Hooshungabad coal, which, having been brought overland a distance of 500 miles, was very much broken, and included a good deal of dust. Steam was raised by the last-named coal 15 minutes earlier, and with smaller consumption of fuel, than by the Scotch coal; and the Hooshungabad coal was manifestly superior in keeping up steam during the whole trial, although not in equal proportion; in consequence of which, we observe that you have authorised the prosecution of further experiments. We think it also particularly desirable that the coal from Hooshungabad should be tried against the best samples of Llangennech and Lewis Cwm Vale coals, as well as against the West Hartley coal lately consigned to you, in order to ascertain their comparative merits as steam fuel; and we shall be

glad to learn the results. The Reports of the Committee for investigating the coal and mineral resources of India, which reached us through the Government of Bengal, represent the coal discovered by Major Ouseley near Chikaly, in the district of Hooshungabad, and elsewhere on the banks of the Nerbudda, to be of excellent quality, and inexhaustible quantity; but the distance of the beds of coal from the sea coast, and the natural difficulties presented by a portion of the intervening country, rendering the carriage of the coal to Bombay very tedious, must make it expensive, and, we fear, operate as a serious impediment to its being brought into extensive use as a steam fuel.

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From Mr. J. H. CRAWFORD, Accountant General, Bombay,

To Lieut. Col. E. M. WOOD, Secy. to Govt., Marine Dept., Bombay.

*Dated the 16th December* 1839.

SIR,

I have had the honour to receive your letter of the 15th ultimo, No. 1707, requesting my opinion and report on the points noticed below, in order that it may be ascertained whether it is practicable to supply this Presidency with coal from the mines which are stated to abound in the Hooshungabad district.

1*st*.—The probable amount of coal consumed at Bombay per annum, in steam navigation.

2*nd*.—The expense incurred in providing the coal in question in round numbers.

3*rd*.—The price per ton, or, if possible, per maund of 80 lbs., in Bombay.

2. I request you will have the goodness to acquaint the Honorable the Governor in Council, in reply, that I find, on communicating with the Superintendent of the Indian Navy, by whose professional experience I have been desirous of correcting my own calculations on the first point, that the quantity of coal required for the use of the Bombay Presidency, in keeping up the steam-packet communication with England by the Red Sea, *the supplies to Suez and Aden included*, cannot be estimated at less than 10,000 tons per annum; but that we have not been able to form any estimate at present of the further quantity that may be required for general purposes when the steam-frigates and other steam-vessels, in progress of completion for service, unconnected with the steam-packet employment, shall be added to the strength of the steam establishment of this Government.

3. In respect to the 2*nd* point I may state, that taking the cost of the coal free on board at Llanelly at 11*s*. per ton, which appears to be the rate contracted for by the Honorable the Court of Directors in England; freight at Rs. 19-8-10, as deduced from the statement of freight transmitted to Government in my letter No. 44 to your address, of the 14th June last; and boat-hire at 4 annas per ton in the fair season (and 10

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|---|---|---|---|
| Prime cost of coal per ton at Llanelly 11*s*., at 2*s*. per rupee .... | Rs. | 5 | 8 0 |
| Freight ..... | | 19 | 8 10 |
| Landing charges at Bombay in the fair season ..... | | 0 | 4 0 |
| Total per ton.. | Rs. | 25 | 4 10 |

annas in the south-west monsoon), according to a memorandum furnished me by the Commissary General on the 25th ultimo, we shall have Rs. 25-4-10 as the cost of a ton of Llanelly coal alongside the wharf at Bombay.

4. In regard to the 3*rd* point, I venture to believe that the new Indian maund of 40 seers, equal to 82⅔ lbs. avoirdupois, is the maund intended to be referred to by Government, as there is not any maund of exactly 80 lbs. avoirdupois in use in India that I am aware of; and in this belief I may add, that as the English ton of 20 cwt., or 2,240 lbs. avoirdupois, contains 27,222 maunds, it follows that a maund of Llanelly coal stands Government in 14 annas and 10 pies, or say in round numbers 15 annas per maund in Bombay, *hamallage not included*, this last item having been omitted as unnecessary in the scale of comparison between Llanelly and Hooshungabad coal, since that charge from the wharf to the warehouse must be incurred in both cases, and will be the same in each.

I have, &c.

*Bombay Castle,* (Signed) J. H. Crawford,
*Accountant Genl.'s Office,* 16*th Dec.* 1839. Accountant General.

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From the Secretary to Government, Marine Dept., Bombay,
To W. Hore, Esq., Assist. Commr. to the Saugor and Nerbudda Territory.

*Dated the* 24*th January* 1840.

Sir,

I am directed by the Honorable the Governor in Council to transmit to you the accompanying copies of the letters which have been received by this Government, in reply to calls, made with the view to elicit information as to whether it is practicable to supply this Presidency with coal from the mines which are stated to abound in the Hooshungahad districts.

2. As there appears to be much uncertainty about the means and cost of conveyance by the river to Broach, the Honorable the Governor in Council is desirous that it should be tested by a consignment of fifty or a hundred tons. The Sub-Collector of Broach will be put in communication with you, for the purpose of making the best arrangements in your power for the conveyance of the coal as far as may depend upon you, and that officer will be directed to co-operate with you in the arrangements that you may make.

3. To what extent it might be advisable to take advantage of the full state of the river after the rains, will be for your consideration; but on this point I am directed to observe, that the coal would be very much deteriorated if it were exposed to the wet. The Governor in Council wishes, however, to leave you entirely unshackled as to the time and manner of sending the experimental consignment down the river, requiring only that all departments that can assist shall do so to the utmost.

I have, &c.

*Bombay Castle,* 24*th Jan.* 1840. (Signed) E. M. Wood, Secy. to Govt.

From the MILITARY BOARD, Bombay,

To Colonel the Hon. SIR GEORGE ARTHUR, Bart., K.C.H.,
Governor and President in Council.

*Dated the* 18*th July* 1844.

HONORABLE SIR,

We have the honour to acknowledge the receipt of Secretary Lieutenant Colonel Melvill's letter No. 821, of the 2nd instant, relative to the coal in the districts on the Nerbudda,—requesting us to take a full review of the subject, and suggest such measures as may be requisite to elucidate or explain it; but as we have not yet had the advantage of the information possessed by the local authorities with whom we have been directed to correspond, we can only observe, that if it be designed to reap the advantages of the mineral resources in the districts alluded to by Major Ouseley, the most important point for consideration appears to be the means of transport.

We are of opinion that the coal could not be profitably brought to Bombay except by means of a line of railroad, or by the Nerbudda river. A survey of the Nerbudda was ordered in October 1841; but in consequence of the officers appointed to the duty being necessitated to proceed on field service, its prosecution was relinquished.

From a plan of the river compiled in 1840, which we beg to submit, there appear to be serious obstructions to its navigation; but these might probably be avoided by means of carriage along the banks of the river where the obstructions exist.

With respect to a railroad, we are not aware of any obstacle to the construction of a railroad between the Presidency and Hooshungabad or Jubbulpore; but such an undertaking, to be worth the expense, involves considerations of the general traffic of that line of country, of which we possess no means of informing ourselves.

No coal, of a sufficiently good quality to work, exists in the Bombay Presidency; that of Kutch proved a failure.

We have, &c.

(Signed) D. BARR, Major General,
Military Auditor General.

„ G. JERVIS, Lt. Col. Comdt.,
Chief Engineer.

„ F. LESTER, Lieut. Colonel,
Member, Military Board.

*Bombay, Military Board Office,* 18*th July* 1844.

From Capt. Sir Robert Oliver, R. N., Superintendent, Indian Navy,

To the Hon. George Russell Clerk, President and Governor in Council.

*Dated the 17th June* 1847.

Honorable Sir,

In forwarding the result of an experiment upon a sample of coal from the Nerbudda, I also append a chemical analysis by Professor Giraud, very kindly performed at my request: there is also a contrasted extract upon a small quantity of coal from the Indus, obtained some few years back.

The apparatus used in the Factory is but an imperfect one,—a small cylindrical boiler, subject from its position to change of atmosphere and draft of funnel, from strength or lightness of the wind.

With all the apparent discrepancies, there is no doubt but this coal is a valuable acquisition, and the more so if the result prove as favourable when used in large furnaces and large quantities, which experience only can determine.

I have, &c.

(Signed) Robert Oliver, Captain R. N.,
Superintendent, Indian Navy.

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From Professor Giraud, M.D.,

To Sir R. Oliver, R. N., Superintendent of the Indian Navy.

*Dated the 12th June* 1847.

Sir,

I have the honour to forward the following results of my examination of the Nerbudda coal you sent me for analysis. It yields in 1000 parts—

| | |
|---|---|
| Solid carbon ..... | 381.97 |
| Gases ..... | 353.73 |
| Incombustible ashes ..... | 264.3 |
| | 1000. |

This composition affords so unfavourable an estimate of the coal, that I was induced to make several repetitions of the analysis; but as these all gave the same results, with only a fractional difference, they may be relied on as correct.

On comparing the above with the composition of British coal, and with that from the Attock which I examined three years ago, it will be found to differ from them in two important respects—1*st*, in its small proportion of solid carbon, on which the heating power of coals mainly depends; and 2*nd*, in the large amount of its incombustible ashes, which constitute its greatest defect.

I have, &c.

(Signed) Herbert Giraud, M.D.,
Professor of Chemistry, Grant Medical College.

*Grant Medical College, 12th June* 1847.

## REPORT BY COMMITTEE APPOINTED TO TEST IN THE STEAM FACTORY, BOMBAY DOCKYARD, SPECIMENS OF THE NERBUDDA COAL.

*Experimental Trial of Government Standard Europe Coal.*

| | |
|---|---|
| Time in getting up steam .. .. .. .. .. .. | 60 m. |
| Coal consumed in that period .. .. .. .. .. | 56 lbs. |
| Time in evaporating 32 gallons of water .. .. .. .. | 30 m. |
| Coal consumed in that period .. .. .. .. .. | 32 lbs. |

*Experimental Trial of Coal said to have been sent from the Nerbudda.*

*First Trial.*

| | |
|---|---|
| Time in getting up steam .. .. .. .. .. .. | 56 m. |
| Coal consumed in that period .. .. .. .. .. | 77 lbs. |
| Time in evaporating 37 gallons of water .. .. .. .. | 30 m. |
| Coal consumed in that period .. .. .. .. .. | 34 lbs. |

*Second Trial.*

| | |
|---|---|
| Time in getting up steam .. .. .. .. .. .. | 36 m. |
| Coal consumed in that period .. .. .. .. .. | 77 lbs. |
| Time in evaporating 32 gallons of water .. .. .. .. | 30 m. |
| Coal consumed in that period .. .. .. .. .. | 26 lbs. |

*Third Experimental Test of the Nerbudda Coal.*

| | |
|---|---|
| Time in getting up steam .. .. .. .. .. | 39 m. |
| Coal consumed in that period { per weight .. .. | 66 lbs. |
| { per measurement .. | 2,597 cub. ins. |
| In one-half hour's subsequent steaming, the quantity of water evaporated was .. .. .. .. .. | 28 gals. |
| With an expenditure of coal { in weight .. .. .. | 28 lbs. |
| { by measurement .. .. | 1,039 cub. ins. |

At the close of the trial the following residue remained, viz:—

| | |
|---|---|
| Below the bars { per weight .. .. .. .. | 11 lbs. |
| { per measurement .. .. .. | 825 cub. ins. |
| Above the bars { per weight .. .. .. .. | 17 lbs. |
| { per measurement .. .. .. | 1,021 cub. ins. |

*Experimental Test of best Government Coal.*

| | |
|---|---|
| Time in getting up steam .. .. .. .. .. | 38 m. |
| Coal consumed in that period { per weight .. .. | 82 lbs. |
| { per measurement .. | 3,043 cub. ins. |
| In one-half hour's subsequent steaming, the water evaporated was .. .. .. .. .. .. .. | 33 gals. |
| With an expenditure of coal { in weight .. .. .. | 23 lbs. |
| { by measurement .. .. | 822 cub. in |

At the close of the trial the following residue remained, viz:—

| | | | |
|---|---|---|---|
| Below the bars | in weight | 18 | lbs. |
| | by measurement | 1,039 | cub. ins. |
| Above the bars | in weight | 9½ | lbs. |
| | by measurement | 920 | cub. ins. |

(Signed) A. Cursetjee,
Chief Engr. and Insp. of Mach.
„ D. Maclaren,
Asst. Chief Engr. & Insp. of Mach.
„ J. Inglis,
Foreman of the Vice-erecting Shop.

*Steam Factory, 16th June* 1847.

Note by Commander Lynch.

I attended these experiments, and am of opinion, that the Nerbudda coal is a very good coal for general steam purposes. It gets up steam quickly, and burns with a clear flame, leaving scarcely any clinker on the bars, and not more than a fair proportion of ash. It is not equal to the best Government coal, but not much inferior for steam purposes.

(Signed) H. B. Lynch, Commander I. N.

*16th June* 1847.

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From R. N. C. Hamilton, Esq., Resident at Indore,

To J. G. Lumsden, Esq., Secretary to Government, Bombay.

*Dated Camp Sonadeh, 1st February* 1848.

Sir,

I have the honour to report, that having reached the vicinity where coal was said to exist, in company with Mr. Johnstone, I examined the bed of the stream in which it was said to be, and found it in three separate places.

2. Enclosed I have the honour to submit a copy of my instructions to Mr. Johnstone, Lieutenant Evans, and Lieutenant Keatinge, and to add that I shall, as soon as I am in possession of sufficient information, report further for the information of His Honor in Council.

I have, &c.

(Signed) R. N. C. Hamilton,
Resident.

*Indore Residency, Camp Sonadeh, 1st February* 1848.

INSTRUCTIONS ALLUDED TO IN THE FOREGOING LETTER, ISSUED BY THE RESIDENT AT INDORE FOR THE GUIDANCE OF MR. JOHNSTONE.

*Dated Camp Sonadeh, 1st February* 1848.

Having now reached the place where coal exists, and visited the spot with you to-day, I think the following instructions may be useful, to enable you to carry out the intention and object of your deputation at my request from Bombay:—

1*st.*—You will examine the coal-field at this place, with a view to ascertaining the extent of the coal basin, the dip, the superficial limits of the outcrop, whether limestone, iron, or any other object of interest that may be in connection with it; and such other points of information which your experience may suggest.

2*nd.*—You will endeavour to form an estimate of the expense at which the coal may be brought to the surface; by what process,—whether any machines will be required; and you will state what means, in your opinion, will be best suited to dig the coal, and bring it to the mouth of the pit.

3*rd.*—You will adopt measures to have 500 maunds of coal dug at once, and brought to the surface at a convenient site for loading: funds will be supplied you; but you must be careful in seeing every payment made, and every claim of workmen satisfied.

Having done what may be necessary to give effect to the above instructions, you will then proceed to examine for coal at other points, bearing in mind that the nearer the coal is found to the Nerbudda, the more easily and cheaply it can be transported to Bombay; and for this reason I would direct your research towards Asseerghur, and if practicable to Beejaghur near Sindwah, Bawurguy near Burwye, and so to the Hurun Pall, where the Satpoora range joins the Nerbudda.

You had better keep a journal, and daily insert whatever you may do. This rough journal can afterwards be transcribed at Indore, where you will come on having completed the inquiries.

If time will admit, you should examine the iron mine near Chandgur Bauglee; and the copper near Kautkot, on the right bank of the Nerbudda, from specimens of the ore; and searching for coal in its vicinity, should there be any indication of its existence.

Wherever you may find coal, you should dig a certain quantity, and store it, to form a depôt; making inquiries in each case as to the dip, extent of basin, &c., and noting the particulars with accuracy in your journal. Such coal-field should bear the name of the nearest large village, or the name of the Purguna. You will intimate to Lieutenant Keatinge where the several depôts may be formed, and he will adopt measures to transport the coal to the river.

To enable you to pay work-people, I make over to you a sum of Rs. 300, and have made arrangements for your being supplied with money on your receipt through the local officers marginally noted, who will attend you.

Lieutenant Evans, Nimar; Deputy Commissioner at Baitool; Deputy Commissioner at Hooshungabad.

You will keep me informed of your proceedings, by sending me weekly a prospective statement, showing where you may be likely to be found in the event of my having anything to communicate to you.

I hope every arrangement has been made to facilitate your inquires: if you should need any further assistance, or find the Native establishments not alert or attentive, you will at once address Captain Spence, Lieutenant Ternan at Baitool, or Lieutenant Evans, as the case may be, and I have no doubt you will meet with every attention.

I need not point out to you the importance of the inquiries entrusted to you: I am satisfied your zeal and ambition will prompt you to every exertion; and I shall have the greatest pleasure in bringing your services to the notice of the Government of Bombay, and of Sir Robert Oliver. All your correspondence regarding coal, or the object of your mission, must pass through me.

(Signed) R. N. C. HAMILTON,
Resident.

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From R. N. C. HAMILTON, Esq., Resident at Indore,

To Lieutenant H. L. EVANS, Political Assistant in Nimar.

*Dated Camp Sonadeh, 1st February* 1848.

SIR,

I have the honour to forward to you copies of the following papers:—

Letter of Instructions, No. 173, of this date, addressed to Lieutenant Keatinge; and Instructions addressed to Mr. A. Johnstone, No. 174.

2. You will see that to Mr. Johnstone is assigned the duty of searching for, and examining into the coal-fields between this place and where the Satpoora hills meet the Nerbudda at the Hurun Pall; and that to Lieutenant Keatinge is entrusted the bringing the coal from the pit to Dharee on the Nerbudda, where it is to be stored, and a depôt formed.

3. Your late trip down the Nerbudda will enable you to make arrangements, by collecting boats of all sizes, &c. previous to the opening of the river, so as to facilitate the transport of the coal to Tullukwara, or the place where sea-going craft can come from Broach.

4. It occurs to me, that the coal may be moved from Dharee before the rains to the Hurun Pall rapids, by contract with the river boatmen at Oonkar, Mundlaisir, and Mhysir; and I request your attention to this point.

5. At some of the rapids or falls, it may be necessary to have blocks, ropes, &c. &c., and other appliances stored, to prevent delay, and the expense of supplying every boat with separate gear; and you will take this subject into immediate consideration, with a view to having all prepared by the time the coal may be moved to Broach.

6. As the services of an efficient Superintendent under your orders will be required for this duty, and as there is a call for such assistance in seeing the coal properly laden and dispatched from the pits, you are authorised to engage, as a temporary arrangement, Mr. Fenwick, of whose fitness you are satisfied, on a monthly salary of Rs. 100,—his pay to commence from the date he may reach Hindea, where instructions for his future guidance will await him.

7. All expenses and charges on account of this experiment, whether incurred by Mr. Johnstone, or by Lieutenant Keatinge, or by yourself, must be met by advances from your treasury; and the accounts, headed "Coal Experiment," must be separately kept in your office, and transmitted to me for adjustment.

8. It will be necessary for you to keep your communication open with Mr. Johnstone whilst occupied in his inquiries; and that the local officers under the hills, and all persons, be required to afford him every assistance, and to attend without demur to all requisitions he may make on them.

I have, &c.

(Signed) R. N. C. Hamilton,
Resident.

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From R. N. C. Hamilton, Esq., Resident at Indore,

To Lieutenant Keatinge, Nimar.

*Dated Camp Sonadeh, 1st February* 1848.

Sir,

It having been determined that you should be associated with Mr. A. Johnstone in place of Lieutenant Evans, whose services cannot be dispensed with in Nimar, I request you will join him as soon as you have completed the examination of the Nerbudda between Hindea and the Dharee falls. I beg your attention to the following observations:—

2. By a perusal of the annexed copy of instructions delivered to Mr. Johnstone, you will see that the search for coal, and the inquiries connected with the coal, form his especial duties; whilst those entrusted to you will be the transport of the coal from the pit to Dharee, on the Nerbudda, where a depôt is to be formed.

3. You will therefore, as soon as possible, collect carriage for the transport of coal from hence to Hooshungabad, on the Nerbudda,—the nearest road being at present through the Kaislah Ghat.

4. You will therefore move to Hooshungabad whenever you think it desirable; and you will collect as many boats of all sizes as may be procurable for hire, and proceed with them to Dharee, taking in coal as you pass. Should it be found nearer to send the coal to any village on the bank, you must make the best arrangements you can (as to hire) with the boatmen; and you will endeavour to make the cost eventually as small as possible, though at first you may be forced to pay high to induce people to venture on a new speculation: however, I am given to understand that the Bunjaras will convey it from this at 4 annas a maund to the river.

5. It will depend upon the means of transport that you may procure how long it will take you to convey the coal to Dharee; and you will yourself remain where you may think your services can be most advantageously employed.

6. You will have the goodness to draw on Mundlaisir for any money you may require; and you will be careful to keep your accounts distinct and clear, that the exact cost of the experiment, as far as you are concerned, may readily be settled.

7. Of course you will keep in constant communication with Mr. Johnstone when he moves on to prosecute his search, so that you may be able to arrange for the transport of coal from any other places he may raise it.

8. It will be proper to keep distinct the coal of each separate pit.

9. Having collected all the coal at the depôt at Dharee, it will be moved, on the opening of the river, towards Broach; for which arrangements must be made by you in communication with Lieutenant Evans, who has been separately addressed by me, and who may possibly be able to get the coal moved to Chikulda, or to the Hurun Pall, by contract, as soon as you report a sufficient quantity collected at Dharee.

10. As there will be a great need of efficient supervision, I have directed Mr. Fenwick to proceed as soon as possible to this place, to act under orders he will receive from you; and you will employ him in the raising and transport of the coal.

11. I need not urge you to afford Mr. Johnstone any assistance in your power towards carrying out the objects of his inquiry; and I am satisfied he will receive from you that cordial co-operation so essential to carry out with success this most interesting and important experiment.

12. A copy of my letter No. 172, of this date, to Lieutenant Evans, is enclosed for your information.

I have, &c.

(Signed) R. N. C. Hamilton,
Resident.

*Indore Residency, Camp Sonadch, 1st February* 1848.

From R. N. C. HAMILTON, Esq., Resident at Indore,

To the SECRETARY TO GOVERNMENT, Bombay.

*Dated Indore Residency, 26th February* 1848.

SIR,

By my despatch No. 171, dated 1st instant, the Honorable the Governor in Council was informed that Mr. Johnstone had joined my camp, and of my intention to proceed direct to the locality near which coal had been found.

On the 2nd February I reached Bhodur, a Jageer village in the Baitool district, situated in the range of hills between the Nerbudda and Taptee. The road from Sindwah Ghat to Nundwara, the foot of the hills, by the route given below, was good and easy for every description of carriage :—

| | | |
|---|---|---|
| Sindwah to Jeelwand | 16½ | miles. |
| Woon | 18¼ | „ |
| Khurgaon | 11 | „ |
| Bhikungong | 10 | „ |
| Sirwul | 12½ | „ |
| Khundwa | 14½ | „ |
| Bhamgheer | 11¾ | „ |
| Chainpore | 16¾ | „ |
| Charnah | 19½ | „ |
| Messenging | 15¾ | „ |
| Timbornee | 17 | „ |
| Seonee | 18½ | „ |
| Nundwara | 8 | „ |
| Bhodur | 16 | „ |
| Sonadeh coal-field | 10½ | „ |

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The pass from Nundwara was hardly practicable for wheel carriages of any description, but there was nothing to prevent a road of easy slope being constructed at the two or three points where alone any impediment occurred.

From Bhodur to Sonadeh, 10½ miles, the path was through a continuous tree jungle, level, and good. Carts are not used by any of the Goond or Koorkoo villages, but they might be introduced; and as the soil is good, could travel at all seasons.

Sonadeh contains seven huts, and belongs to Toonia Patel, who pays Rs. 5 a year to the Jageerdar of Bhodur, within whose limits it is situated.

About half a mile from the village is the nulla called Bowree, a mountain torrent in the rains; the bed was deep sand, with pools of water here and there. In the left bank, under a layer of sandstone (where the stream had scoured away the sand), coal was seen cropping out. Here it was that Colonel Ouseley had discovered it; and not far from this spot, higher up, Mr. Conybeare had excavated the coal sent by me last year to Bombay, the experimental trial of which was sent to me with your despatch No. 961, dated 17th July last.

In communication with Mr. Johnstone, I determined that he should at once commence work. Toonią Patel and his two sons, with three more men, were all we could collect in the neighbourhood: these, with some Bildars belonging to my camp (being supplied with tools I had brought), soon cleared away the sand, and laid bare the seam. On excavating, we found that the coal seam was 20 inches thick; that the angle was 7½°, and lay between two layers of shale, each 4 inches thick, embedded in sandstone: the upper stratum was coarse-grained, and soft, 30 feet to the surface of the land; the lower was coarse-grained, and hard.

The coal we raised burnt well, without refuse, and was pronounced by Mr. Johnstone to be equal to the main coal of Scotland, and perfectly adapted for use in Bombay.

This result determined me to raise at least 20 tons (from 500 to 600 maunds), and I set to collect workmen for this purpose. Meanwhile Mr. Johnstone proceeded to survey the neighbourhood, so as to form an opinion of the probable extent of the basin.

I think I am safe in stating that the basin extends throughout the space enclosed by the surrounding hills, and may be estimated at 15 miles by 20; but as I shall hereafter furnish a detailed report on this branch of the subject, I propose confining myself for the present to noticing what has been done, and what may be assumed as the cost of raising and transporting the coal under present circumstances.

As soon as I had put everything in train, I was compelled to leave Mr. Johnstone, being obliged to return to Indore. I had intended leaving Mr. Keatinge with Mr. Johnstone; but that officer's services were not available, and after his examination of the Nerbudda I directed him to return to his proper duties in Nimar.

Whilst with Mr. Johnstone, very material assistance was rendered to me by Ensign Edwards, of the 49th N. I., Adjutant of the Malwa Contingent, who commanded my escort, and by Mr. Sub-Assistant Surgeon Tranter; indeed, without the aid rendered by these two officers, our difficulties would have been much greater, as the presence of an European was found to be absolutely necessary whilst the mining was going on, the Natives being ignorant of the mode of working the seam, and the nature of the work giving cause to apprehend slips; indeed one occurred, which at first was alarming,—one man was buried under a large rock, which came down suddenly whilst we were at the pit, and but for our presence, most probably the delay in extricating the sufferer would have proved fatal; as it was, by our joint exertions he was got out, and immediately attended to by Dr. Tranter, who found severe contusions on the legs, and bruises on the body; and by applying the proper remedies I am happy to say the man has quite recovered.

The panic thus created amongst the Natives nearly put a stop to the work: three only appeared the next morning,—the Patel and his sons. However,

Mr. Johnstone's personal exertions, and our encouragement, restored confidence, and workmen were after a few days as abundant as ever.

It being impossible for me to leave Ensign Edwards or Dr. Tranter, and having no one else available, I was constrained to send for Captain Fenwick, late in the Nizam's service, in whose knowledge of the country, of the Natives, and of the customs of the merchants, I had full confidence; and I offered to him a salary of Rs. 100 per mensem, to cover his expenses.

Captain Fenwick at once came from Indore, and joined Mr. Johnstone; and, under my instructions, upon him devolved the arrangements for transporting the coal from the pit.

Mr. Johnstone has reported that 20 tons have been raised; and Captain Fenwick that he has engaged with Bunjaras at Seonee, with whom I had commenced negotiations, to convey that amount to Dharee, on the Nerbudda, for 5 Nagpore rupees per manee of 12 maunds of 40 seers each. By this the coal will cost on the bank of the Nerbudda at Dharee something under 7 annas per maund.

From Dharee to the Hurun Pall it can be conveyed by water, before the rainy season, at a cost of 2 annas a maund, making the total cost to the Hurun Pall 9 annas a maund.

Thence to Tullukwara, or the point at which one of the Government lighters from Bombay can come, the cost may be 2 annas, or even 3 annas more per maund; so that for 12 annas a maund, or Rs. 21 a ton, the Nerbudda coal is now available to the Government.

I shall be obliged by instructions whether I shall raise any more coal at the pit, and what quantity. Work at the pit can be carried on till June next, and the coal brought to Dharee, on the Nerbudda: after that date, or the setting in of the rains, there may be difficulty; but as it will be impossible to work the coal from the bed of the river, I requested Mr. Johnstone to sink a common shaft, and he informs me that he has commenced on one, but details have not yet reached me.

Mr. Johnstone has from the first evinced a zeal, intelligence, and personal activity most creditable to him, and without which I could not have carried out the inquiries now reported. To Captain Fenwick, also, my acknowledgments are due, for the successful manner in which he has carried out my views in making the contracts with the Bunjaras.

I have, &c.

(Signed) R. N. C. HAMILTON,
Resident.

*Indore Residency, 26th February* 1848.

From R. N. C. HAMILTON, Esq., Resident at Indore,

To the SECRETARY TO GOVERNMENT, Bombay.

*Dated Indore Residency, 2nd March* 1848.

SIR,

In continuation of my despatch No. 300, dated 26th ultimo, I have the honour to forward, for submission to the Honorable the Governor in Council, the annexed copy of a letter from Mr. A. Johnstone, replying to queries addressed by me to him regarding the coal at Sonadeh.

I have, &c.

(Signed) R. N. C. HAMILTON,

*Indore Residency, 2nd March* 1848. Resident.

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From Mr. A. JOHNSTONE,

To R. N. C. HAMILTON, Esq., Resident at Indore.

*Dated Camp Sonadeh, 25th February* 1848.

SIR,

In answer to your letter of the 13th ultimo, I have the honour to submit to you the result of my inquiries on the Sonadeh coal. I have seen it in several places in the Bohra river, and had a sketch, marking the places where it is exposed, and shall give you the measurements I have taken at three of the best of the places. The first I shall notice is the place where Colonel Ouseley raised some coal eight or nine years ago,—on the sketch it is first, marked A: sandstone 12 feet; shale 11 inches; coal 6 inches; shale 11 inches; coal 7 inches; shale 4 inches. B, is a place where I had opened a few days ago; the measurements—sandstone 20 feet; clay 3 inches; loose shale 11 inches; coal 6 inches; shale, very hard, and mixed with sand, 4 inches; coal 14 inches; shale 8 inches. C, is the mine we have been raising the coal from for the present experiment: sandstone 30 feet; shale 4 inches; coal 18 inches; shale 4 inches. All the places at which I have seen coal in the Bohra river, I have marked with cross lines in the sketch.

2. *The Quality of the Coal.*—It seems to me a very good coal for marine purposes, and in that I am borne out by the Coal Committee's Report on the same coal in the Bombay Dockyard, where they had every means of ascertaining its real value. Its specific gravity is 1.392, as taken from the mine.

3. The coal lies in a northerly direction, and at an angle of from 8° to 10°,—a very convenient angle to work.

4. *The Thickness of the Seam.*—You will see, from the dimensions given, that it varies in thickness from 6 to 19 inches.

5. *The best Mode for Working*, it seems to me, is to have a number of shafts put down, and from the bottom work from all the four sides, driving a roadway 4 feet high by 3½ feet wide, and subdivide it into rooms or galleries. However, that will be much better determined on after seeing the coal at the bottom of the shafts, and the appearance of the roof, and whether there is likely to be any difficulty in ventilating the mine, or any appearance of explosive gas.

6. *The Transmission of the Coal to Bombay.*—In this lies the greatest difficulty: at present the Bunjaras are rather indifferent about taking the coal at all; but a few trips would cure them I suppose. Mr. Fenwick has made an arrangement to have the coal taken from here to Dharee for 5 Nagpore rupees per manee, or at the rate of Rs. 13 per ton. Carts seem to me better adapted for the work, and there are only about three miles of the road by Sewnee impracticable for carts: an outlay of four or five thousand rupees would make a good road all the way, when the price might be brought down, perhaps to one-half even, by the Bunjaras. The price we pay now ought not to be taken as a fixed rate, if the coal were worked on a large scale, perhaps 2,000 tons per month. The Bunjaras would have a return cargo of grain and other necessaries for the workmen; one bullock-cart, with four bullocks, would carry a ton, and make two trips per month, and at the rate of Rs. 4 per bullock would be Rs. 8 per ton. The expense from Dharee to Bombay must be answered after the first cargo goes down the river.

7. *The Expense of Digging and Carrying away the Coal.*—At present it is 8 annas or 9 annas per ton. One man can dig 13 maunds per day with ease, and one man is sufficient to carry away the coal from two; and they are paid at the rate of 2 annas per day,—that is, 6 annas for 26 maunds of 80 lbs. each.

8. *The Extent of the Coal Basin.*—This is a question that will require some time before any correct idea can be formed. If I may judge from the outward appearance of the country, it is very probable the coal extends all over the basin between the hills, which is about 20 miles by 14. I have been round the greater part of it, but have not as yet seen coal in any other river than the Bohra. I would here recommend the propriety of putting down a number of bores, not only to ascertain the extent of the seam of coal we have just been working, but to ascertain the strata to be found below; and if the sites are carefully selected, a very correct idea may be formed of the whole basin. There is a well at Dharee at present nearly full of water,—in the month of May it is nearly dry: I have directed Mr. Fenwick to examine it, and see if there is any appearance of coal. It is about 50 feet deep. There is another at Bohra, also nearly full of water: that also I have requested him to see when it gets dry, and bring away a specimen of the rocks passed through. I attach a good deal of importance to the putting down of some bores, as recommended above: upon that will depend, in a great measure, the value of that basin. You will see by the dimensions I

have given that we shall find the coal very unequal in thickness, like all other surface coal.

9. I am not prepared at present to give anything like an estimate of the machinery necessary: that will depend a great deal on the quantity of water. I should think, for the present experiment, that one pair of bullocks, and the common frame used for drawing water from the wells, would suit all requirements: the expense of putting down shafts will be better ascertained after we get the present one finished, which is going on rapidly. Should anything else appear to me worthy of being brought to your notice, I shall not fail to write you before leaving this. There is one great difficulty we labour under at present, that is the price of the grain, which would be overcome if the works were carried on, on a large scale. It sells here about 30 per cent. higher than at Sewnee, although the distance is only about 30 miles, and causes a great deal of discontent among the workmen.

I have, &c.

*Camp Sonaleh, 25th February* 1848. (Signed) A. JOHNSTONE.

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From R. N. C. HAMILTON, Esq., Resident at Indore,
To the SECRETARY TO GOVERNMENT, Bombay.

SIR, *Dated 3rd March* 1848.

I have the honour to submit a Report from Mr. A. Johnstone, in which he notices having found another coal-field, at Mardanpore, the seam of which is 2 feet 4 inches. The angle is great (20°), but the coal Mr. Johnstone considers superior. It is situated still further from the plain of the Valley of the Nerbudda, and from Dharee, the place of embarkation, than Sonadeh.

I now beg to submit an estimate of the probable cost of working one shaft, and the probable out-turn; and to solicit the orders of the Honorable the Governor in Council, whether operations shall be continued or suspended.

The cost of working one shaft for twelve months will be Rs. 6,364; the out-turn is estimated at 10,920 tons of coal; which would give a rate of about 9⅓ annas per ton, or about an anna for 3 maunds.

It will be impossible to depend upon the Bunjaras for the transport when the working is large: in the first place, daily loading and unloading would break the coal; and in the second, it would be found cheaper to cut the road where bad, and to have carts.

The road need only be made an easy fair-weather track, such as a four-bullock cart with a ton of coal could travel.

I have traversed the country, and speak confidently,—that there is nothing to prevent carts being employed, except just in the height of the rains, from Sonadeh to Dharee, on the Nerbudda, where, I am of opinion, the coal should

be stored, and floated down the river as far as possible, which in the rains may be, below Tullukwara, to where the sea-going craft may be able to come up, and up to April as far as the Hurun Pall, from whence carts, I apprehend, would be found the cheapest carriage.

An estimate of the cost of carriage must at best be guess-work, until actual experiment affords certain data.

A four-bullock cart, at the rate of Rs. 4 a month per bullock, would be Rs. 16; and this for two trips per mensem would make the carriage of the coal Rs. 8 per ton, and the total cost on the river bank Rs. 8-9-4 per ton; to add for the carriage to Hurun Pall Rs. 6 per ton, and Rs. 5 thence to the sea, will make the coal Rs. 20 a ton; but it must be borne in mind that the carts and boats will make something in the return trips, and that when an organized system of communication is established, and a return hire obtained, the cost of the coal will be reduced.

I shall, therefore, be obliged by instructions for my future guidance.

If operations are carried on, Mr. A. Johnstone must be directed to remain at Sonadeh, and his salary determined. He will require two assistants,—one, Captain Fenwick, on a salary of Rs. 200 a month; another on Rs. 200, to superintend the depôts at Dharee and Hurun Pall,—with less than this number the work could not be properly superintended; and a Native establishment of three Karkoons on Rs. 20 each (Rs. 60), and ten Chuprasees on Rs. 40,—in all Rs. 100,—will also be required. A Native Doctor should be added.

I need not point out the advantages which will result from the port of Bombay being independent of foreign supply for its coal, or the profit to the country by the expenditure of capital in the very centre of a dense, uninhabited, though fertile tract. Sooner or later a railway must extend from Bombay to Delhi: its first portion will be to the Nerbudda, which must be crossed, I think, at the Dharee falls, the locality and bed of the river being peculiarly favourable at that place.

The entire bed of the river is basalt: the stream, after passing over near a mile of this hard surface, precipitates itself down a chasm cut in the basalt bed about 40 feet, as I have endeavoured to describe in an accompanying sketch; then forces itself round the hard basalt through a passage about 50 yards wide, the sides of which are precipitous basalt;—over this a bridge could be thrown with ease. Hence, by the Bauglee Ghat, the ascent to the table-land of Malwa can, I think, be attained at a favourable gradient, as far, at least, as my examination enabled me to judge.

The finest iron in this part of the country, not very inferior to the black main of Scotland, abounds on the right bank of the Nerbudda, in the vicinity of Dharee, at Chandgur, Kautkot, and along the lower hills. Specimens of this I procured on the spot; and I will take an early opportunity of sending them, with those of the coal, shale, &c., to the Asiatic Society's Museum in Bombay.

I have just had a Report from Mr. Fenwick, by which His Honor in Council will be able to appreciate some of the difficulties we have to overcome in getting the Natives to take up a new trade, or assist in carrying out the experiment.

I have, &c.

(Signed) R. N. C. HAMILTON,
Resident.

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From Mr. A. JOHNSTONE,

To R. N. C. HAMILTON, Esq., Resident at Indore.

*Dated Camp Mardanpore, 28th February* 1848.

SIR,

Just as I was starting from Sonadeh for this place, the day before yesterday at 3 P. M., the Bunjaras arrived (300). There is plenty of coal to load the whole of them. I expect by the time I get over to Sonadeh, this morning, that the coal will be off. I have seen the coal here: it lies at a very great angle (20°), and in the direction of north-west; the thickness is 2 feet 4 inches, and its specific gravity is 1.229. It seems to me superior to the Sonadeh coal, if I may judge from its appearance. On my way to this place—about two miles from Bohra, and in the bed of the river Sookee, about 100 yards from its junction with the Towah river—I saw some more coal, but very thin,—only 3 inches thick, and not regular. I received the account of the boring tools being on their way to Sewnee. I shall send off for them to be sent on to Sonadeh, and mark a couple of places for Mr. Fenwick to put down bores. I should like to have remained here, to have seen a fair commencement made; but that I cannot do, seeing the extent of country you wish me to visit before the month of May. However, I shall explain to Mr. Fenwick how to proceed with the boring operations. I have made the shaft at Sonadeh large enough to admit of a pair of pumps, in the event of the water being too much for bullock-power. There is a small high-pressure engine lying in store in the Bombay Dockyard: it was made for the purpose of instructing the apprentice boys; and I think the Government gave permission for the experiment to be tried, but not to exceed Rs. 800; so, if it was required here, they could not charge more for it than that sum. It is about 10 horse-power, and about 2 tons in weight without the boiler, which would be another 3 or 4 tons. It has got pumping apparatus,—6-inch pumps, and 18-inch stroke,—made for Aden; but was rejected on account of their taking up 10 feet of room, when the well was only 2 feet diameter. However, we must first consider what a pair of good strong bullocks can do. I annex an estimate I have prepared of the probable expense of working one pit.

I remain, &c.

*Camp Mardanpore, 28th February* 1848. (Signed) A. JOHNSTONE.

*Estimate alluded to in the preceding Letter.*

Bullock-power 5 cwt. raised 60 lbs. per min.

60

300

5 hours constant work.

20) 1,500

75 tons total weight per day.

Water 5,600 gals. = 25 tons, to be subtracted from 75, the remainder is

50

— 10 rubbish.

40

100 men 8 as. each 5

35 tons of coal per day.

26 working days per month.

210

70

910

12

10,920 tons of coal.

| | |
|---|---|
| 100 miners, at Rs. 4 each per month | Rs. 4,800 |
| 10 men keeping the roads in repair below, at Rs. 4 each. | 480 |
| 10 men for stowing away the coal at the top of the pit, Rs. 3 each | 360 |
| 2 Native overseers, at Rs. 10 each | 240 |
| 1 smith, at Rs. 8 per month | 96 |
| 1 carpenter, at do. do. | 96 |
| 1 bellows-man, at Rs. 4 | 48 |
| 2 bullocks, at Rs. 4 per month. | 96 |
| 1 driver, at Rs. 4 per month. | 48 |
| Interest on Rs. 2,000 for tools, &c. at 5 per cent. | 100 |
| Total. | Rs. 6,364 |

I have calculated the shaft at 60 feet deep,—it may be 10 feet more or less; and the water, too, is a guess, I think, on the safe side: all the other items are sure calculations. This amount would, I think, be sufficient to work one pit; and the cost is rather more than 9 annas per ton. It would be necessary to have a European who understood coal working for a couple of years, to get the colliery properly set going. This calculation is after there is roadway for 100 men to work; the first six months, of course, the amount of 35 tons of coal per day could not be raised.

(Signed) A. Johnstone.

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From Captain R. H. Fenwick,

To R. N. C. Hamilton, Esq., Resident, Indore.

*Dated Sonadeh, 28th February* 1848.

Sir,

In continuation of my letter of the 24th instant from Sewnee, I regret to have to acquaint you that the Bunjaras whom I had engaged at that place, and who arrived here the day before yesterday, on seeing the coal, at once

refused unconditionally to take it up, without any reference to the terms of their agreement; declaring that their bullocks would be destroyed by the pricking of the sharp points of the large pieces. Nevertheless, I had four sacks filled, in which not more than two pukka maunds could be stowed away; but when they were placed on the backs of the bullocks, two of them laid down, and all threw their loads down. It became apparent that, in the shape the sacks assumed when filled, the least thing would throw them off. However, imagining it to be the trick of the Bunjaras, I insisted on the performance of their engagement; and after an altercation of the whole day, towards the evening they consented to take about 300 maunds, with the view of loading their bullocks with less than 2 maunds each, when they started another impediment, that they would not, under any consideration, agree to unload in the manner I pointed out,—that is, by lifting the sacks from the backs of the cattle, and placing them carefully on the ground, so as to prevent the pieces of coal from breaking, turning almost into powder by being roughly thrown down, according to the usual practice with grain, cotton, &c. This objection on their part I have not been able to overcome, and the Naik has absented himself without intimation. The tone assumed by the Bunjaras induces me to believe that it will be difficult to induce them to carry the coal at all, at any rate so as to secure its delivery at Dharce in the state necessary to render it of any value. I have deemed it proper to lay the above before you, for your consideration and future orders. Should I, however, succeed in making the Bunjaras abide by their agreement, and secure the object desired, of placing the coal at Dharee in a proper condition, I shall at once take advantage of it, and address you promptly on the subject.

I am not prepared, from such information as I possess at present, to say whether it would be practicable to employ carts; but I fear not at a rate to bring the cost within the limits pointed out in your instructions. They could only be loaded at Nundwara, to which place pack-bullocks would have to be employed; and the difficulties and impediments abovementioned would thus far still exist. The hire of a four-bullock cart from Sewnee to Indore is 12 Nagpore rupees, and the load 20 pukka maunds. What it would be from hence to Nundwara I am unable to form an opinion just now. I beg leave respectfully to add here, that the want of a Hindee writer prevents my communicating with, and procuring assistance and information from, the Native authorities at Sewnee, Shahpoor, and other places.

The Bunjaras now here declared their intention of taking the route by Bordah and Sewnee, declining the one by Pophlia, Sungasun, and Hurda, decidedly.

As soon as I am enabled to come to a definite conclusion with the Bunjaras, I shall have the honour of addressing you again.

I have, &c.

(Signed) R. H. Fenwick.

From R. N. C. HAMILTON, Esq., Resident at Indore,

To the SECRETARY TO GOVERNMENT, Bombay.

SIR, *Dated Indore Residency, 10th March* 1848.

In continuation of my despatch No. 345, dated 3rd instant, I have the honour to forward copy of a letter from Mr. Fenwick, dated 4th instant, reporting having persuaded the Bunjaras to take the coal; and of another from Mr. Johnstone, dated 2nd instant, reporting having found a route practicable for carts, requiring but a trifling outlay to make it easy and good; also of a further letter dated 7th instant, from Mr. Fenwick, which has just reached me.

I have, &c.

(Signed) R. N. C. HAMILTON,

*Indore Residency, 10th March* 1848. Resident.

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From Captain R. H. FENWICK,

To R. N. C. HAMILTON, Esq., Resident at Indore.

SIR, *Dated Sonadeh, 4th March* 1848.

In continuation of my letter of the 28th ultimo, I have now the honour to report that the Bunjara Naiks returned yesterday; and I have at last prevailed with them to take up the coal, which is now being packed in their sacks. I hope to be able to see them off to-morrow. What quantity they will be able to carry, they cannot themselves say at present. I shall not fail to write to you again on the subject in a day or two.

It is necessary I should acquaint you, that after consulting with Mr. Johnstone, who left this for Mukrai on the morning of the 1st instant, I resolved upon accompanying the Bunjara bullocks myself to Dharee, taking with me the eleven Bildars and three Sungturashes now employed here, to ensure the careful loading and unloading of the sacks. The Bunjaras could not be induced to move without my doing so. The digging of the shaft will therefore be suspended till my return. We have gone down to 13 feet, and are now working in a bed of sandstone.

I have also the honour to acquaint you that Mr. Johnstone, on leaving this, placed in my hands an order from Captain Spence for Co.'s Rs. 300, on the Sewnee Tuhseel, which I doubt not will be duly realized.

In conclusion, I beg to inform you that I have now with me one of the Residency Chuprasees, two peons from Shahpoor, and the two village peons whom I entertained at Sewnee, at Rs. 4 a month each. The carpenter, blacksmith, and bellows-boy shall be left here to prepare timber for supporting the sides of the shaft to the sandstone foundation, which is at 9 feet from the surface.

I have, &c.

*Sonadeh, 4th March* 1848. (Signed) R. H. FENWICK.

From Mr. A. JOHNSTONE,

To R. N. C. HAMILTON, Esq., Resident at Indore.

*Dated Camp Gowasing, 2nd March* 1848.

SIR,

I have got good news for you (not that I have found a bed of coal, for I am now in the centre of basaltic rocks), but I have found a good *road* for the coal, where carts may go all the way to Sonadeh. I made notes of the road as I passed along, and I am of opinion that a good cart-road can be made for Rs. 500; in fact, the road is already made, with the exception of two ascents near Sonadeh, about 3 miles to the west;—at present there is only a footpath. The ascent is about 1 in 15, and 200 feet long. All the rest of the road is like a bowling ground,—a few furrows here and there, that would require to be filled up; and all along the road there are lots of small stones, varying from 2 inches to 6 inches diameter; so you might have a beautiful metal road very cheap. From Sonadeh to Peepliah is 14 miles (I think); from Peepliah to Sander about 6 miles,—this is the place where we joined the Baitool cart-road. From there to Gowasing is about 6 miles, and in that distance there are only two ascents of any importance. They seem about 1 in 18,—a very good angle for a cart-road, and in capital order. These ascents are opposite Sowhghur, which we passed on our right about half a mile. I sent the Shewpore Chuprasee with a note to Mr. Fenwick, advising him to come this way with the coal, it being a much better road, shorter than by Bardow, Nundwara, and Sewnee. There is plenty of water all along the road every couple of miles or so, and lots of grass. I wish you had gone by this way instead of that miserable road between Bardow and Nundwara. The only thing to be said against this route is the want of supplies,—nothing to be had but *grass* and *water*. I left Sonadeh at 6 A. M. on the morning of the 1st, and arrived at Membia, about a quarter of a mile past Peepliah, at 11 A. M. I had stopped a good many times on the road, and walked mostly all the way. Left Membia on the 2nd, at half-past five, and arrived here at 10 A. M. I shall make a short march to-morrow of 8 miles to a place called Kudassee, on the road to Hurda. From there I am told there is a good road to Mukrai, and provisions to be had. If we get this road opened, the rate of carriage will be much reduced, and we should be independent of these Bunjaras, who seem to be rather troublesome customers to deal with. They were still holding out when I left; but Mr. Fenwick had made up his mind to take his whole force, and proceed along with them, and let the shaft stand for a time.

I shall be at Mukrai the day after to-morrow, and shall write you from that place, if I should see anything worth bringing to your notice.

I have, &c.

(Signed) A. JOHNSTONE.

From Captain R. H. FENWICK,

To R. N. C. HAMILTON, Esq., Resident at Indore.

*Dated Sonadeh, 7th March* 1848.

SIR,

In continuation of my letter of the 4th instant, I have the honour to acquaint you that I leave this to-morrow morning with 462 maunds of coal on 226 bullocks, and hope to deliver it at Dharee in about 20 days, in the state it has been packed here. I propose taking with me eight Bildars only, and leaving here the Residency Chuprasee with three Sungturashes, three Bildars, and the artificers, to go on with the shaft. The Russid peon from Shahpoor remains here, the other I shall take with me as far as Hurda.

I shall have the honour of addressing you as I proceed, to keep you informed of my progress. I shall take the route recommended by yourself, and since examined by Mr. Johnstone, and found to be far preferable to the one by Sareeam and Nundwara, both as to the levelness of the road and convenience of water; but it is quite a desolate tract for more than 28 miles. I have however provided Russid for my party for that distance.

I am, &c.

(Signed) R. H. FENWICK.

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MARINE.

From A. MALET, Esq., Chief Secy. to Govt., Bombay,

To R. N. C. HAMILTON, Esq., Resident at Indore.

*Dated 4th April* 1848.

SIR,

I am directed to acknowledge the receipt of your letters Nos. 300, 334, 345, and 367, dated respectively 26th February, and 2nd, 3rd, and 10th ultimo, with their several enclosures, reporting the result of the investigations lately made in the coal-beds in the vicinity of the Nerbudda, and to convey to you the thanks of the Honorable the Governor in Council for the exertions you have made on this occasion, in a cause which, in its ultimate results, may be of vast importance, not only to the public works at this Presidency, but to the steam marine, and to the progress of railroads in Western India.

2. The Honorable the Governor in Council desires to afford to you all the aid in the power of the Government. At present its means are limited to the services of Mr. Johnstone, and pecuniary assistance.

3. The Governor-in Council is pleased to allow Mr. Johnstone to remain to superintend the coal-mining operations, and requests that he may be permitted to accompany the first convoy of boats laden with coal to Broach.

Mr. Johnstone being a civil engineer, his skill in many ways will prove of use in rafting the coal down the Nerbudda, erecting cranes, &c.; while perhaps his geological knowledge will lead to the discovery of mines nearer to the river than those now reported on.

4. It will be intimated to the Commander in Chief of the Indian Navy, that the Governor in Council trusts, that considering the nature of the service, he will not feel the want of Mr. Johnstone until the time when he may be expected here in charge of the first cargo of coal ever floated down the Nerbudda.

5. As the estimate of charges which you have submitted is based on speculation in a matter of which, as yet, very little is known beyond the existence of superior coal, the Honorable the Governor in Council is pleased to place at your disposal the sum of Rs. 10,000, to be expended as your daily increasing experience may dictate; and requests that you will be so good as to furnish an account of the outlay. His Honor in Council would simply urge economy, and the necessity of gradually feeling your way; seeking for other coal-beds nearer the river, lower down, and avoiding more than simple clearances for laden carts and cattle to pass over, for future discoveries may throw in the rear the present beds, and on the close of the season it will be easy in the calculations to make allowances for bad roads, &c.

6. I am to inform you, that there being no immediate want of coal in Bombay, you need not on that score hasten your operations; and to suggest (should your local experience and inquiries bear out the views of His Honor in Council) the formation of magazines on the river, floating the coal down according to its state from depôt to depôt, thus acquiring an accurate knowledge of the river in all its bearings and peculiarities.

7. The salary Mr. Johnstone may deserve, in addition to his fixed pay, the Honorable the Governor in Council is pleased to leave to you to decide; and trusts that it, and all other charges, will be defrayed from the Rs. 10,000 above sanctioned.

8. The Governor in Council instructs me to suggest to you, that it might be well now to consider the proprietorship of the soil where the coals are found, and the best means of leasing or otherwise obtaining a right to work the mines; and to request that you will be so good as to give some information on the tolls and customs which Chiefs on the banks can levy on the coal in transit; such statistics being necessary to enable this Government to lay the matter in a complete form before the Government of India.

I have, &c.

(Signed) A. MALET,
Chief Secretary.

*Bombay Castle, 4th April* 1848.

From R. N. C. HAMILTON, Esq., Resident at Indore,

To the SECRETARY TO GOVERNMENT, Bombay.

*Dated Indore Residency, 31st March* 1848.

SIR,

I have the honour to report, for the information of the Honorable the Governor in Council, the arrival of the coal at Dharee on the Nerbudda, whence it will be sent by water as far as it is possible to float the boats at this season of the year. I expect, however, that they must be unloaded near the Hurun Pall, and the coal sent from thence to Mokree, or near to it, by carts, there being a good cart-road in that quarter.

From Mokree the coal can be conveyed by water to the place where a pattimar or other vessel of small draft may be sent from Bombay, for its conveyance.

If the *Snake*, or other small steamer, could be sent from Bombay, with orders to proceed up the Nerbudda as far as the depth of water would allow at this season, some certain information and facts as to the capability of navigating the lower course of the river would be obtained before the monsoon, which would serve as a guide in future despatches.

Having in my several Reports endeavoured to place all the facts before His Honor in Council, I beg to offer the following proposition, supposing it be intended to work the Nerbudda coal-fields with a view to supplying the Government demand at Bombay.

To work the coal mines, the following establishment will be necessary:—

A Superintendent. This must be a practical man, conversant with coal-mining, and the management of the workmen at the pit. The Government could not select a better or more fit person than Mr. A. Johnstone, who has proved, by his exertions, his qualification, and who has a zeal and an interest in the work. His salary should be Rs. 600 per mensem for two years certain, from 1st January 1849.

Mr. Johnstone should have under him two Apprentices, to be selected for their qualifications, and to receive each Rs. 50 a month.

This would be a sufficient establishment, efficient to superintend all works at the pit; and to this must be added workmen according to the subjoined scale for every shaft that might be sunk:—

| | | |
|---|---|---|
| 100 | Miners, at Rs. 4 each.... | Rs. 400 |
| 10 | Bildars, at ditto ..... | 40 |
| 10 | Men to stow coal ..... | 30 |
| 2 | Native Overseers, at Rs. 10.. | 20 |
| 1 | Smith..... | 8 |
| 1 | Carpenter ..... | 8 |
| 1 | Bellows-man ..... | 4 |
| 2 | Bullocks, hired ..... | 8 |
| 1 | Driver ..... | 4 |
| | Total..Rs. | 522 |

For the transport of the coal from Sonadeh to Dharee, Mr. Johnstone has found an easy and practicable cart-road, which being repaired after the rains, the coal could be brought cheaper and safely to Dharee.

For the superintendence of the transport department, there must be one superintendent, with two assistants.

The local costs of superintendence would then be Rs. 1,000 per mensem, viz :—

| | |
|---|---|
| One Superintendent at .. .. .. .. .. | Rs. 600 |
| Two Apprentices at Rs. 50 .. .. .. .. | 100 |
| One Superintendent at .. .. .. .. .. | 200 |
| Two Assistants at Rs. 50 .. .. .. .. .. | 100 |
| Total.. .. | Rs. 1,000 |

Captain Fenwick would have the general charge of the transit department, and his two assistants be available for moving with despatches, or for being located at such places as experience may hereafter point out as requiring their presence.

It is for the Government to determine whether operations shall commence as soon after the rainy season as possible; and if so, to intimate the number of tons of coal that shall be raised: 20,000 tons could be raised and sent to Bombay next year, and a much larger quantity if the Government should direct. The cost of the coal at the pit may be estimated at 9 annas a ton, or Rs. 11,250 for 20,000 tons; the cost of carriage, as soon as there is a certainty in the employment, will fall considerably, and be still lower when the return trade is created, by which back hire for carriage will be saved; but even if a ton of coal were to cost the first season Rs. 20 in Bombay, the money would be well laid out, for by the existing means of supply the Government have to pay 32*s.* 6*d.* a ton, which at 2*s.* the rupee is Rs. 16-4-0; and this, it must be borne in mind, is in time of peace, when freight is low, and there is only ordinary sea risk to be covered.

I beg to state that I have given orders to continue sinking one shaft at Sonadeh, the expense being about Rs. 100 per mensem, and that I propose continuing this work until the setting in of the rains.

I do not yet despair of finding coal in the vicinity of Baug, in a locality on the right bank of the Nerbudda, no great distance from Hurun Pall. Should coal be there found in quantities, and of a good quality, half the expense of transport will be saved; but at present I am not able to speak with any certainty on the subject.

I beg to recommend Mr. A. Johnstone to the favourable notice of His Honor in Council. He is at present labouring under a severe attack of fever, brought on from exposure, but is convalescent. His exertions have been unwearied and incessant; so have those of Captain Fenwick, and who likewise, I hope, will be considered to have earned the approbation of Government.

I have, &c.

(Signed) R. N. C. Hamilton,

*Indore Residency*, 31*st March* 1848. Resident.

MARINE DEPARTMENT.

From A. MALET, Esq., Chief Secy. to Govt., Bombay,

To R. N. C. HAMILTON, Esq., Resident at Indore.

*Dated 26th April* 1848.

SIR,

I am directed to acknowledge the receipt of your letter No. 438, dated 31st ultimo, with its enclosure, and to observe, that my letter No. 544, of the 4th instant, anticipates in many respects the wishes expressed in your present communication.

2. The Commander in Chief of the Indian Navy will, I am to inform you, be requested to take measures to carry out the views expressed in the 3rd paragraph of your letter.

3. Mr. Johnstone having been sent from Europe for a specific purpose by the Honorable the Court of Directors, the Honorable the Governor in Council cannot, I am to state, without their permission, comply with your request to place Mr. Johnstone's services at your disposal for two years from the 1st January 1849; but Mr. Johnstone may for the present, and pending orders from the Home Government, remain in the Valley of the Nerbudda; and in the interim the strong recommendation of Government will be submitted to the Honorable Court, that the services of Mr. Johnstone may be devoted to the coal-mining undertaking for the period indicated.

4. Though undoubtedly the demand for Nerbudda coal by this Government may become urgent, the Honorable the Governor in Council would confine himself to simply asking you to feel your way; the more so as you anticipate finding coal at Baug, near the river at Hurun Pall. If coal from the Nerbudda can be had in abundance, and at a reasonable rate, the demand of Government for it will be almost unlimited. I am therefore to request that you will not relax in your operations in the present sites, while seeking for others lower down the river.

5. In supersession of the instructions contained in the 3rd paragraph of my letter above alluded to, the Honorable the Governor in Council directs me to request that you will pass the coal to Broach, or wherever the Commander in Chief of the Indian Navy can arrange for its reception, under the care of Captain Fenwick, who should thence return to the mines, or wherever you may desire, in order to raft more coal down, and become well acquainted with the navigation of the river; but this His Honor in Council would leave to your judgment.

6. The Honorable the Governor in Council requests that you will convey to Mr. Johnstone and Captain Fenwick the acknowledgments of Government for the services they have rendered.

I have, &c.

(Signed) A. MALET,

Chief Secretary.

*Bombay Castle, 26th April* 1848.

From the GOVERNMENT OF BOMBAY,

To the Honorable the COURT OF DIRECTORS FOR AFFAIRS OF THE HONORABLE EAST INDIA COMPANY, London.

*Dated Bombay, 25th April* 1848.

HONORABLE SIRS,

We have the honour to forward, for the information of your Honorable Court, copies of our proceedings, relative to an experiment now being made to obtain coal from the Valley of the Nerbudda.

2. In December last, we beg to state, the Resident at Indore requested that the services of Mr. Johnstone, an Engineer of the Dockyard, might be placed at his disposal, to collect information relative to certain coal-fields found near the Nerbudda; and suggested that he might be allowed for his travelling expenses Rs. 10 per diem for four or six months.

3. The Superintendent Indian Navy having reported that the services of Mr. Johnstone could be spared, he was directed on the 22nd December to proceed to Indore, and the time of his detention at that place was left to the discretion of Mr. Hamilton, the Resident.

4. In the latter end of February, the Resident reported that he had visited a place called Sonadeh, in company with Mr. Johnstone, and discovered a seam of coal 20 inches thick, from which he had caused 20 tons to be raised, and hoped to be able to lay it down at Tullukwara, on the banks of the Nerbudda, whence it can reach the sea, at the rate of 12 annas a maund, or Rs. 21 a ton. He further stated, that to aid in the transport of the coal from the pit to the point of shipment, he had engaged the services of a Captain Fenwick, late of the Nizam's service, at an expense of Rs. 100 per mensem.

5. On the 3rd March, Mr. Hamilton communicated to us that he had found another coal-field, at Mardanpore, a place more distant from the point of shipment than Sonadeh, the seam of which is 2 feet 4 inches thick, and the coal superior to that found at the last-named place.

6. In soliciting to be informed whether the experiment should be continued, the Resident stated the estimated cost of working one shaft for twelve months would be Rs. 6,364, the out-turn of which might be estimated at 10,920 tons of coal, being at the rate of 9¼ annas per ton.

7. The Resident further observed, that except in the height of the monsoon, carts can be used all the way from Sonadeh to Dharee on the Nerbudda, where the coal can be stored, and in the rains floated down to the Hurun Pall, from whence it can be conveyed in carts to Tullukwara, or the place of shipment.

8. In regard to the portage, the Resident observed that the cart-hire to the bank of the river would be Rs. 8-9-4 per ton, the carriage from thence to Hurun Pall would be Rs. 6 per ton, and from thence to the sea Rs. 5 per ton, making the coal cost Rs. 20 per ton at the place of delivery; but this, he trusted, would be reduced when an organised system of communication is established, and return hire obtained for the carts.

9. If the operations are to be carried on, continued Mr. Hamilton, Mr. Johnstone must be directed to remain at Sonadeh, with two Assistants on Rs. 200 per mensem, and a Native establishment of three Karkoons on Rs. 20 each, and Chuprasees at Rs. 40 per mensem, with a Native Doctor.

10. On the receipt of this Report, in view to afford all the aid in our power, we allowed Mr. Johnstone to remain to superintend the coal-mining operations, and requested the Resident to permit him to accompany the first convoy of boats laden with coal to Broach. We placed the sum of Rs. 10,000 at the disposal of the Resident, to be expended by him as his experience might dictate; care being being taken that all the expenses incident to the experiment were covered by that sum.

11. At the same time, we suggested to the Resident the formation of coal magazines on the banks of the river, as also the floating of the coal down, according to the state of the river, from depôt to depôt, by which an accurate knowledge of the river would be acquired. We also requested the Resident to consider the proprietorship of the soil where the coal was found, and the best means of leasing, or otherwise obtaining a right to working the mines; and to report as to the tolls and customs which Chiefs on the banks of the river could levy on the transit.

12. On the 31st March, the Resident informed us of the arrival of a batch of coal at Dharee on the Nerbudda, and requested that a small steamer might be sent, with orders to proceed up the Nerbudda as far as the depth of water would allow, by which certain information could be obtained as to the capability of navigating the lower course of the river before the monsoon.

13. The Resident also suggested, if it were intended to work the mines to supply the Government demand for coal, that Mr. Johnstone should be appointed Superintendent, with a salary of Rs. 600 per mensem for two years certain, from the 1st of January 1849; that he should have under him two Apprentices, on Rs. 50 each, to superintend the works at the pit; and for each shaft that might be sunk an establishment of miners, &c., the aggregate of whose pay should be Rs. 522 per month.

14. For the superintendence of the transport department, the Resident further proposed, that Captain Fenwick should be appointed Superintendent, on a salary of Rs. 200 per mensem, with two Assistants at Rs. 50 each, which will make the proposed local cost of superintendence Rs. 1,000 per month.

15. In concluding his Report, Mr. Hamilton stated that he had given orders to continue sinking one shaft at Sonadeh, at an expense of about Rs. 100 per month, and that he did not despair of finding coal near to Hurun Pall, in which case the expense of transport would be reduced one-half.

16. We have instructed the Commander in Chief of the Indian Navy to act in accordance with Mr. Hamilton's wishes, and we informed that gentleman, that Mr. Johnstone having been sent from Europe for a specific purpose by your Honorable Court, we could not without your permission comply with his request; but that, pending the receipt of your Honorable Court's instructions,

Mr. Johnstone might remain in the Valley of the Nerbudda. We would now strongly recommend to your Honorable Court to allow Mr. Johnstone's services to be devoted to the coal-mining undertaking for the period indicated.

17. Though undoubtedly our demand for Nerbudda coal may become urgent, and almost unlimited, we have simply requested Mr. Hamilton to feel his way—the more so, as he anticipates finding coal at Baug; and that he would not relax in his operations in the present sites, while seeking for others lower down the river.

We have, &c.

(Signed) George Clerk.
„ Willoughby Cotton.
„ L. R. Reid.
„ J. P. Willoughby.

*Bombay Castle, 25th April* 1848.

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From R. N. C. Hamilton, Esq., Resident at Indore,

To the Secretary to Government, Bombay.

*Dated Indore Residency, 27th April* 1848.

Sir,

I have the honour to state, for the information of the Honorable the Governor in Council, that the coal under charge of Captain Fenwick reached Chikulda, not far from the Hurun Pall, on the 20th; and that measures have been taken to store it there until the Nerbudda rises sufficiently to allow of laden boats going over the rapids below the Hurun Pall.

2. Chikulda is a post of the Malwa Bheel Corps, and a capital place for a depôt: there is a bungalow there, occasionally occupied by Captain Wilkie, the Bheel Agent, when on duty at Burwanie, the godowns attached to which are available.

I have, &c.

(Signed) R. N. C. Hamilton,
Resident.

*Indore Residency, 27th April* 1848.

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From Captain Fenwick, on Special Duty,

To R. N. C. Hamilton, Esq., Resident at Indore.

*Dated Chikulda, 24th April* 1848.

Sir,

I received your letter of the 13th instant, on board at Akbarpoor, at 3 A. M. of the 17th, and also the official instructions. I beg you will accept my unfeigned thanks.

In mentioning to you now my arrival here at 2 P. M. on the 20th, I have to apologise for not apprising you of the same earlier. The only excuse I shall plead is, that I wished to look about me a little before I addressed you. On making inquiries, I learnt that there was not water enough in the river for laden boats to proceed to Hurun Pall; in consequence, I forthwith set about landing the coal, and storing it up in an empty godown attached to the bungalow at this place. The next day I was occupied in the above work, and by the evening 150 bags were housed. The 386 bags are now in the godown. Yesterday morning I left this in a small boat for Hurun Pall, to examine the state of the river, and that formidable obstacle, personally, and arrived at the Hurun Pall (a distance of about 15 miles) at 3 P. M. In several places in the river there were not more than 6 inches of water; and over some of the rocky passages, my boat, empty as it was (for I had no baggage at all with me, and only two Bildars, one Chuprasee, and one servant), had to be dragged, I may say almost lifted over; laden boats 30 feet by 5, with 2½ manees, cannot float freely in less than 18 inches of water. I passed the night at Dhurmai.

This morning at 6 o'clock I proceeded in the boat to examine the falls below the Pall,—these being the serious obstacles, and not the Pall itself. There are three rapids, with falls at their heads, at the distance of about a quarter of a mile from the Pall, and 100 yards from each other. The first has a fall of about 6 feet in 30; the second of 3 feet, and the third of 4 feet; and the force with which the water rushes against projecting pointed rocks on either hand of a channel not more than 10 or 12 feet wide, renders the passage extremely difficult and dangerous,—I might say impracticable in its present state. Empty boats may be let down and dragged up, as is the case at Sasradana; but this could not be done with laden ones at all. A channel to the left hand, falling into the principal one on the right, about one mile below the Pall, forming the island called the Hurun Pall Bheet (*Bheet* is an island), was pointed out to me, and examined; but it has no outlet at this time of the year.

From the above, and under many considerations, I think Chikulda should be the spot selected for a depôt.

I sailed from Hurun Pall on my return at 10 A. M., and came here at 3 P. M. with a brisk westerly breeze.

I beg to inform you that I lost no time, on my arrival here on the 20th, in making inquiries after carts to be hired to take the coal to Tullukwara, intending to dispatch two or three of them, agreeably to your directions. I am sorry to say there are no carts to be hired; but the authorities at Burwanie and Chikulda have offered to procure a couple for me. As soon as they are forthcoming I shall load them, and accompany the coal to Tullukwara and Broach, and then return by water, if it can be done; otherwise by the land route. Ragoba Balkishn, Native agent at Burwanie, produced Bunsara Naik to take the coal to Tullukwara, under engagement to pay Rs. 5 per bullock, or Rs. 2 per maund. I need not add that the Naik was at once dismissed.

I should have been quite ready and happy to have visited Baug, to look after coal, and superintend those occupied in searching under your instructions,—the heat of the weather would not have been in my way in the least; but I am promised the carts by to-morrow or the next day, and as this is the primary object just now, I shall postpone my trip to that place until my return, which, I trust, will be agreeably to your intentions.

In this place I cannot hesitate in coinciding with yourself in respect to the Sonadeh works. I do not think they could be carried on satisfactorily, except under European supervision; and the person employed should be, in my opinion, a professional and experienced engineer;—an intelligent Native, however, could in the mean time go on with the shafts to any depth, just as they do with some of their wells to 100 feet, and even more. I beg to submit for your information a copy of the Hindee letter which I sent to Huri Chuprasee from Mundlaisir, through Captain Spence. If you could conveniently send a cooley-load of good country gunpowder to Sonadeh, it would materially help in forwarding the sinking of the pit. I had some samples procured from Boodah; but it was very bad, and it quite escaped me to send for some from Hurda. The Sungturashes understand blasting rocks perfectly.

I have, &c.

(Signed) R. H. Fenwick.

24*th April* 1848.

P. S.—The Karkoon has just come in from Baug, and says he had not been able to trace anything of coal anywhere.

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From R. N. C. Hamilton, Esq., Resident at Indore,

To the Secretary to Government, Bombay.

*Dated Indore Residency, 3rd May* 1848.

Sir,

I have the honour to forward, for submission to the Honorable the Governor in Council, copy of a Journal on the passage from Dhar to Hurun Pall, kept by Captain Fenwick, in charge of the boats laden with coal.

2. Captain Fenwick had proceeded from Chikulda, with two carts laden with 48 maunds of coal, towards Tullukwara, and has reported his arrival at Ali Rajpoor on the 30th, and his expectation to reach Tullukwara on or about the 6th instant.

I have, &c.

(Signed) R. N. C. Hamilton,
Resident.

*Indore Residency, 3rd May* 1848.

## CAPTAIN FENWICK'S JOURNAL,

*Alluded to in the foregoing Letter from* Mr. HAMILTON.

| Date. | Distance in Miles. | Names of Villages or Rapids. | Remarks. |
|---|---|---|---|
| 1848 | | | |
| April 5th | .. | Dharee..... | The boats being laden below the falls, were loosened from their moorings at sunrise on this date. |
| „ | 0½ | Kingayethtur Tur Rapid. | Not difficult; there is a good sandy beach or landing-place here on the Ponassa side, but the jungle must be cut for five or six hundred yards from the road to the landing place. |
| „ | 3½ | ..... | Deep water the whole way; detached rocks in the river, but not dangerous. At Kumlatur, 5 feet water, with bad rocks in the channel. This is considered one of the worst places between Dharee and Mundhata; laden boats are let down with ropes, and empty ones dragged up. |
| „ | 1 | ..... | A narrow passage near the right bank; 6 feet water; detached covered rocks here and there, to be carefully avoided. |
| „ | 1 | ..... | Deep water; ruins of Kinchgur on the right bank, and junction of the Kumair river. |
| „ | 2 | ..... | A fine large, broad, deep pool all the way; rocks here and there. |
| „ | .. | Bukutgur..... | A rock in the middle of the river, the point just appearing above the water. |
| „ | 0¾ | Chota Chokee Tur .. | 4 feet water; not difficult channel; narrow passage; boats more than 6 feet beam could not pass without great danger; laden boats are let down with ropes, and empty ones dragged up. |
| „ | 0½ | Kotekhera ..... | A deserted village, on the left bank. |
| „ | 0¼ | Sillanee..... | Some rocks from above Kotekhera, hidden under water; to be carefully looked after. |
| | 9¾ | miles..... | By the Natives, 5 kos from Dharee. |
| April 6th | 2 | Byronpurun Tur .... | 4 feet water; passage narrow, with three turnings; difficult for laden boats, which are let down with ropes, and empty ones hauled over through small outlets, with less than 1 foot of water. |
| „ | .. | Oukerjee. | |
| „ | .. | Mundhata. | |
| „ | 0¼ | Markundee Tur .... | 4 feet water; narrow passage. |
| „ | 0¾ | Kooharee Tur ..... | Ditto ditto ditto. |
| „ | 0¼ | Bhallarow Tur..... | 4 feet water; considered, and is, a very difficult one; extending for more than 100 yards; laden boats are carefully let down with ropes. |

| Date. | Distance in Miles. | Names of Villages or Rapids. | Remarks. |
|---|---|---|---|
| 1848 | | | |
| April 6th | 4¼ | ..... | A very deep and broad pool all the way from Kothar (or Kothown) Ghat; some hidden rocks here and there, but not dangerous. |
| „ | 0½ | Choaria Tur ..... | 4 feet water; rocks in the channel; passage narrow, as usual; Chorar river joins here on the right bank. |
| „ | 0¼ | Dheria Ghat. | |
| „ | 1½ | Kheiree Ghat. | |
| „ | 1 | Mytak Kheiral..... | A Goojir village, on the right bank. |
| „ | 0¼ | Katghura Tur ..... | This rapid extends about 600 yards, and is studded with rocks; channel dangerous; between 4 and 5 feet water; laden boats let down with ropes. It must in the present state of the river be always difficult. |
| „ | 0½ | Bimlay Sur ..... | Temple and Dhurumsala, on the right bank. |
| „ | 0½ | Alliagaum ..... | On the left bank; one Bunnia; fowls procurable with trouble. |
| | 12¼ | miles ..... | By the Natives, 6 kos from Sillanee. |
| | | | [N. B.—It appears to me, from the present state of the river between Dharee and Alliagaum, that boats of more than 6 feet beam, 30 or 35 feet in length, with 2½ feet water sides; flat bottom; the bottom side planks of one log, scooped out thus ⌊ ⌋, would be the only ones that could be generally used. During the very height of the river in the monsoon, I think no boats could live at some of the places, where most dangerous whirlpools and high waves must be formed. The boatmen corroborate this opinion.] |
| April 8th (Sunset). | 1 | Seemala ..... Tokra ..... | Right bank. Left bank. } Just below Goromookh Dhurumsala. |
| „ | 1 | Pithungur ..... | Left bank. |
| „ | .. | Kupas Tur ..... | Right bank. |
| „ | 0¼ | Wakee Tur ..... | 5 feet water; 8 feet channel in the middle; numerous rocks on either side, with one foot water over them; the boat struck constantly. |
| „ | 1 | Krian ..... Khygaum..... | Right bank. Left bank. |
| | | | [N. B.—The Rapid Wakeetur may be said to extend almost the whole way; channel in some places not more than 8 feet wide; in some parts very bad; only 1 foot water over the rocks; boats let down with ropes. |
| „ | 2 | Sangoor ..... | Right bank; Oamattee left bank; fine broad and deep pool. |
| „ | 1 | Kawere..... | Left bank; broad deep pool the whole way; Sitokee and Kowreea right bank. |
| „ | 0½ | ..... | Rapids the whole way, very difficult and dangerous; in several places not more than 1 foot water over the rocks, with which the bed is studded. |
| „ | 0½ | Surkaree Tur ..... | 300 yards, 6 feet water, but dangerous from high waves; side rocks, and a fall of 3 feet. |

| Date. | Distance in Miles. | Names of Villages or Rapids. | Remarks. |
|---|---|---|---|
| 1848 | | | |
| April 8th | .. | Bakawan ..... | Left bank. |
| „ | 0¼ | Bhundwarra Tur.... | 5 feet water ; in one place very bad. |
| „ | 0¼ | Mundana Ghat .... | Left bank ; Byeran right bank. |
| | 7¾ | miles. ..... | 4 kos, according to Natives, from Alliagaum ; left at 11 A. M., arrived at sunset. |
| April 9th | .. | ..... | Left Mundana Ghat at sunrise, and arrived at Mundlaisir at 2 P. M. |
| „ | 0¼ | Mundana Tur ..... | Extending 300 yards ; channel in some places 8 feet wide ; 2 feet water. |
| „ | 1 | Puthrar ..... | Right bank ; Nagawan left bank. |
| „ | 1 | Bhutyan ..... | Left bank. |
| „ | 2 | Soolgaum..... | Rocks all the way, and shallow in many places. |
| „ | 7¾ | Mundlaisir ..... | In many places very shallow, with rocks the whole way, but nowhere dangerous, though very tedious for laden boats ; studded also with low grass islands. |
| | 12 | miles. | |
| April 13th | .. | ..... | Evening at Myhesur. |
| „ | 1 | ..... | Shallow, with rocks. |
| „ | 3 or 2½ | ..... | Fine deep pool, and broad. |
| | 3½ | miles. | |
| April 15th | .. | ..... | Evening at Sasradana. |
| „ | 1 | ..... | Fine deep, broad pool. |
| „ | .. | Sasradana Falls and Rapids. | Extend for about 400 yards ; several falls of 3 and 4 feet ; channel 8 to 10 feet wide ; very bad rocks in the channel ; empty boats let down with ropes, with great difficulty. |
| | 1 | mile. | |
| April 16th | .. | ..... | Left Sasradana at 12 o'clock, and arrived at Akbarpoor at 5 P. M. |
| „ | 0½ | ..... | Channel narrow and deep ; it would be very bad, I think, in the rains. |
| „ | 0½ | ..... | Channel widening to 100 yards ; 18 inches water at one place ; boats let over. |
| „ | 0¼ | ..... | Broad pool ; not very deep. |
| „ | .. | Zallimpore ..... | Left bank. |
| „ | 0¼ | ..... | Deep and broad pool. |
| „ | .. | Tutkotee ..... | Right bank. |
| „ | 1 | ..... | Channel between rocky islands. |
| „ | .. | Sussungaum. | |
| „ | .. | Manwa Bhiltur .... | Channel 8 feet ; 4 feet fall ; 2 to 3 feet water ; very bad rocks on either hand. The boats were half emptied, and let down with ropes, and men holding on each side ; re-laden at the bottom of the rapid, 30 or 40 yards. The rapid winds along for 30 |

| Date. | Distance in Miles. | Names of Villages or Rapids. | Remarks. |
|---|---|---|---|
| | | | or 40 yards, dashing against the rocks on either hand with great force. The boatmen behaved remarkably well, and the Bildars were very useful. |
| 1848 | | | |
| April 16th | 2½ | ..... | Shallows in a few places, but generally broad, open, and deep. |
| „ | .. | Akbarpoor. | |
| | 5 | miles ..... | 3 kos by the Natives. |
| April 17th | .. | ..... | Left Akbarpoor at 9 A. M.; two of the boats changed, being old, and in a leaky state. Arrived at Kuthora near sunset. |
| „ | .. | Moogurree ..... | Opposite to Akbarpoor. |
| „ | 1 | Chota and Burra Rhul. | Right bank. |
| „ | .. | ..... | River open, and deep all the way. |
| „ | .. | Akbarpoor Tur ..... | 50 yards; 15 inches water over the rocks; loose stones removed from the channel; rapid not dangerous, but tedious; boats handed over, or rather dragged along; 300 yards below there is a fort. |
| „ | 0¼ | A Rapid ..... | 18 inches water over the rocks; boats let down with ropes, about 50 yards. |
| „ | 0¼ | Peepulda ..... | Right bank; a little above there are some rocky islands, but the channel is deep, and a pool the whole way from the last rapid. |
| „ | 0½ | Chiklee..... / Nimbala ..... | Left bank. / Right bank. } Many bad rocks; channel along the left bank. |
| „ | 3¾ | ..... | [Pencil memorandum lost on board.] |
| „ | 1¼ | Adulpoor ..... | Left bank. } Pool all the way from Chiklee. |
| „ | .. | Bhowa ..... | Right bank. } |
| „ | .. | Bhownesur Tur .... | 40 yards; 2 feet water over the rocks; 8 feet passage; channel winding, difficult, and dangerous; boats let down with ropes, with much trouble. This is one of the worst rapids in the river; at the bottom there is a fall of 3 feet, 7 feet passage; rocks on each hand, and a very bad and dangerous one in the middle, at the outlet, to be feared the most; this rock should be removed. |
| „ | 1 | ..... | Pool, deep water; rocks here and there. |
| „ | .. | Burreea ..... | Left bank. |
| „ | .. | Kola Tur ..... | 100 yards; 2 feet water, and less; very bad and difficult at the end, from a rock in the middle of the channel. |
| „ | 0½ | Kathoral ..... | Left bank; pool all the way. |
| | 8½ | miles ..... | 4 kos by the Natives. |
| 18th April | .. | ..... | Left Kuthora at 6 A. M.; arrived at Kirmee at 5 P. M. |

| Date. | Distance in Miles. | Names of Villages or Rapids. | Remarks. |
|---|---|---|---|
| 1848 | | | |
| April 18th | 0½ | Bilkesnore Pagoda .. | On the points of Dhurmapooree *Bheet* (island), 2 miles long; right channel dry; left channel a broad pool, 6 feet deep; a rock in the middle, opposite the temple. |
| ,, | .. | Dhurmapoorce..... | Right bank. |
| ,, | .. | Khooj Nuddee. | |
| ,, | 0¼ | Khoojawan ..... | Good pool; 6 feet water. |
| ,, | 0¼ | Burreea ..... | Left bank; good pool; jhow jungle along the right bank. |
| ,, | 1½ | Huthnawar ..... | Left bank. |
| ,, | .. | Binkote ..... | Right bank; pool all the way to this. |
| ,, | .. | Huthnawar Tur .... | Shallow rapids for 500 yards; boat dragged over the loose stones in several places. |
| ,, | .. | Ghatmora Tur..... | Fall of 3 feet; 7 feet passage, and very bad; boats let down with ropes held on each bank; 4 feet water. This rapid is called Ghatmora Tur. |
| ,, | 0½ | Ghatmora Phal ..... | 5 feet water; 10 feet channel; a fall of 2 feet; boats lowered over with bamboo poles very dexterously. |
| ,, | 0½ | ..... | Rocky islands and shallows. |
| ,, | .. | Khutargaum ..... | Right bank. |
| ,, | .. | Nundgaum ..... | Left bank. |
| ,, | .. | Loolgaum ..... | Right bank. |
| ,, | .. | Buhamungaum .... | Left bank; river studded over with rocks and low islands; shallows all the way. |
| ,, | 0¼ | Wishwanath Khira .. | Pool, with rocky islands. |
| ,, | .. | ..... | A narrow passage along the left bank; a small rapid with 4 feet water; rocks in the channel. |
| ,, | 3 | Mohapur..... | Right bank; a small pagoda; good pool the whole way, with some rocks here and there. |
| ,, | 0¼ | Nuktia-ke-Phal Tur . | Not bad; 5 feet water; 10 feet channel. |
| ,, | 0½ | ..... | Deep pool; Chiklee left bank. |
| ,, | 0¼ | ..... | Bad rocks; some under water, some just appearing above; 6 feet water, with a slight stream. |
| ,, | 0¾ | ..... | Man river joins here on the right bank; pool, with rocks here and there. |
| ,, | .. | ..... | A rapid, with rocks and loose stones; 2 feet water. |
| ,, | 0½ | Neemla Tur..... | Bad rocks in the channel; boats let down by the hand; 2 feet water; channel 8 feet. |
| ,, | 0½ | ..... | Broad, deep pool. |
| ,, | .. | Nulwaree..... | Left bank. Deb nudee joins here. |
| ,, | .. | Ruthwa ..... | Right bank. |
| ,, | 1¼ | Lohaea..... | Left bank. |
| ,, | .. | Mullungaum ..... | Right bank; broad deep pool all the way. |
| ,, | 1¼ | Koimee ..... | Left bank. |
| ,, | .. | Burdha Bazong .... | Right bank; deep and fine broad pool the whole way. |
| | 12⅓ | miles ..... | 6 kos according to the Natives. |

| Date. | Distance in Miles. | Names of Villages or Rapids. | Remarks. |
|---|---|---|---|
| 1848 | | | |
| April 19th | .. | ..... | Left Kirmee at 7 P. M.; arrived at Lahana Burda at 5 P. M. |
| ,, | 0½ | ..... | Pool, with sunken rocks, and rocky islands. |
| ,, | 0½ | ..... | Ditto ditto ditto. |
| ,, | .. | Ansurpoora ..... | Left bank. |
| ,, | .. | Surwapoora ..... | Right bank. |
| ,, | .. | ..... | River covered with sunken rocks, and rocky islands; deep channel in some places, and 2 feet water in others; intricate passage, but not dangerous. |
| ,, | 0½ | ..... | The same state of the river continues. |
| ,, | .. | Chirasein Tur ..... | Very winding and bad channel for 300 yards; in one place 15 inches water; boats led over by the hand. |
| ,, | .. | ..... | A bluff, high, isolated rock in the middle of the river, 150 yards below the rapid. |
| ,, | 0½ | Macepoora ..... | Left bank. |
| ,, | .. | ..... | A small rapid. |
| ,, | .. | Oordhumia ..... | Right bank. |
| ,, | .. | ..... | Shallow continued. |
| ,, | .. | ..... | A very shallow part; 9 inches water; a channel had to be made, by removing the loose stones from the middle, and piling them up on each side for 150 yards, to deepen the stream to 15 inches, when the boats were dragged over. Half the day taken up in the above work. |
| ,, | 0¼ | ..... | Another shallow, 6 inches water; the stones removed as above, and a channel formed of 15 inches depth for 30 yards. |
| ,, | .. | ..... | At 300 yards another similar shallow, overcome in the same way. |
| ,, | .. | ..... | A bad rapid; to be worked through very cautiously, though deep, the channel being very narrow, with rocks. |
| ,, | 0½ | Dunterwarra ..... | Left bank. |
| ,, | 1 | ..... | Pool full of rocks, under water, the boats striking on them constantly. |
| ,, | .. | Gollata..... | Left bank. |
| ,, | .. | Peerkheira ..... | Right bank. |
| ,, | 1¼ | ..... | Rocks and shallows, and deep channels; intricate passage. |
| ,, | .. | Lahana Burda..... | Left bank. |
| ,, | .. | Semurla ..... | Right bank. |
| | 5 | miles..... | 3 kos by the Natives. |
| | | | [N.B.—The laden boats require 18 inches of water to float freely. The largest boat is 31 feet long, and less than 5 feet wide, laden with 2½ manees. |
| April 20th | .. | ..... | Left Lahana Burda at 7 A. M.; arrived at Chikulda at 2 P. M. |

| Date. | Distance in Miles. | Names of Villages or Rapids. | Remarks. |
|---|---|---|---|
| 1848 | | | |
| April 20th | 1 | ..... | Achota, right bank. |
| ,, | .. | ..... | Pool, with rocks here and there. |
| ,, | 1¼ | ..... | Fine deep pool; some rocks along the left bank. |
| ,, | .. | Ekulara ..... | Right bank. |
| ,, | .. | Owhee ..... | Left bank; a ferry here; a tope of fine tamarind trees. |
| ,, | .. | ..... | 500 yards; dangerous hidden rocks, with some of their points just appearing in the middle of the river. |
| ,, | 1 | ..... | Good pool. |
| ,, | .. | Kawthee ..... | Right bank. |
| ,, | .. | ..... | Shallow; 2 feet water; studded with rocks; no regular channel. |
| ,, | .. | Kamana Tur (bow-shaped). | 300 yards; 2 feet water; deepest channel with bad rocks in the middle; boats constantly striking on them; in one place the boats were let down with ropes. |
| ,, | 1½ | ..... | Shallow, with rocks and loose stones the whole way; boats continually striking on them. There is a ford here. |
| ,, | .. | Ganglee ..... | Right bank. |
| ,, | .. | Peeplodh ..... | Left bank. |
| ,, | 0¼ | ..... | Shallows. |
| ,, | .. | Domekhul Tur..... | A very bad rapid; 15 inches water; rocks in the channel, against which the current rushes with great force; a fall of 3 feet; boats dragged over; some loose stones being removed. |
| ,, | 1 | ..... | Shallows and rocks; 15 inches water in some places. |
| ,, | .. | Bhaboot ..... | Left bank. |
| ,, | .. | Zowhoor ..... | Right bank. |
| ,, | 0¾ | ..... | A bad sunken rock in the middle of the river; one of the boats got on it, and was nearly rolling over; the rest of the river a fine broad pool, with 5 or 6 feet water generally. |
| ,, | 0½ | ..... | Pool; 5 feet water. |
| ,, | .. | Kusrawath ..... | Left bank. |
| ,, | 1½ | ..... | Rocks and shallows; channel between irregular low rocks, &c. |
| ,, | .. | Chikulda. | |
| | 8½ | miles..... | 4 kos by the Natives. |
| April 22nd | .. | ..... | Left Chikulda in a boat 30 feet by 4½ feet. |
| ,, | 1¼ | ..... | Pool; 6 to 8 feet water. |
| ,, | .. | Bilkheira ..... | Left bank. |
| ,, | .. | ..... | 4 feet water. |
| ,, | .. | ..... | Shallow; 18 inches water. |
| ,, | .. | ..... | Rocks. |

| Date. | Distance in Miles. | Names of Villages or Rapids. | Remarks. |
|---|---|---|---|
| 1848 | | | |
| April 22nd | .. | ..... | A small rapid ; 1 foot water. |
| ,, | 1¼ | ..... | Shallow in some places, with less than 1 foot water ; little rapids and rocks. |
| ,, | .. | Nandgaum ..... | Left bank. |
| ,, | .. | Kaperkheira ..... | Right bank. |
| ,, | 0½ | ..... | Shallow the whole way ; boat shoved along ; in some places not 6 inches water ; sandy bed all across the river. |
| ,, | 0½ | ..... | A nice little pool ; 5 feet water ; no rocks. |
| ,, | .. | ..... | Rocks scattered all across the river, with irregular channels of 4 and 5 feet water. |
| ,, | 0½ | ..... | A bed of rocks ; narrow channels ; 3 and 4 feet water. |
| ,, | 0½ | ..... | River spread with rocks ; a small pool ; 4 feet water. |
| ,, | .. | Kutora..... | Left bank. |
| ,, | 0½ | ..... | A fine broad, deep pool. |
| ,, | .. | ..... | River spread with low detached rocks ; channels between ; deep water. |
| ,, | 0½ | ..... | The same as above. |
| ,, | .. | Sonewul ..... | Left bank. |
| ,, | .. | Kurronja..... | Right bank. |
| ,, | 1½ | ..... | Fine deep pool. |
| ,, | .. | ..... | A small bed of rocks in the middle of the river ; dangerous. |
| ,, | 0¼ | Kotral ..... | Right bank. |
| ,, | .. | ..... | Pool continued. |
| ,, | .. | ..... | Ooree nudee joins here, on the right bank. |
| ,, | .. | ..... | Pool continued. |
| ,, | .. | ..... | Rocks on the right hand. |
| ,, | 0½ | ..... | 2 feet water ; low, sunken, and some appearing ; rocks spread all over. |
| ,, | 0¼ | Meijnaik Tur ..... | 9 inches water ; full of rocks in the channel ; scarcely any passage at all. The laden boats could not have been got over ; a fall of 3 feet. |
| ,, | .. | ..... | A small old pagoda on the right hand, exactly opposite the fall ; my boat was literally lifted over. |
| ,, | .. | ..... | Another similar rapid, but not so bad. |
| ,, | .. | ..... | Goee nudee joins here, on the left bank. |
| ,, | 1½ | ..... | Deep pool ; two or three rocks just above the water. |
| ,, | 0¼ | Gowlia Tur..... | 4 and 5 feet water ; bad rocks in the channel, and at its outlet. |
| ,, | 0¼ | ..... | A small rapid ; 9 inches water ; no regular channel. |
| ,, | 0¼ | ..... | Bluff peak of the first hill on the immediate banks of the river ; right bank. |
| ,, | .. | ..... | Fine deep and broad pool. |
| ,, | 0¼ | ..... | Pool continued ; sunken rocks ; some just showing themselves above the surface of the water. |

| Date. | Distance in Miles. | Names of Villages or Rapids. | Remarks. |
|---|---|---|---|
| 1848 | | | |
| April 22nd | .. | ..... | Ruins of the Gurhee of Deheir, on a hill on the right bank. |
| „ | .. | Deheir ..... | Right bank. |
| „ | 1 | ..... | Pool continued; broad and deep. |
| „ | .. | Beejasein Phal..... | A shallow; stones to be removed; not 6 inches water. |
| „ | 0¼ | Beejasein ..... | Left bank. |
| „ | 1 | ..... | Deep, broad pool, with numerous sunken rocks; jhow jungle on the right hand; resort of tigers. |
| „ | .. | Moorgutta Tur..... | 3 and 4 feet water; channel winding and bad, with rocks. |
| „ | 0¼ | Moorgutta ..... | Left bank. |
| „ | 1½ | ..... | Pool, with sunken rocks; shallows; no regular channel. |
| „ | .. | ..... | Tar; shallow, &c.; good for a quarter of a mile. |
| „ | .. | Dhurmray ..... | Right bank. |
| | 14½ | miles..... | According to Natives 7 kos. |
| April 23rd | .. | ..... | Left Dhurmray at 6 for the Hurun Pall. |
| „ | .. | Dhurmray Tur..... | Considered the head of the Hurun Pall passage; 18 inches water; bad rocks for 200 yards. |
| „ | 1 | ..... | Small pool, with rocks; 4 feet water; a rapid; 18 inches water, 6 feet channel. |
| „ | .. | ..... | River full of rocks; deep water. |
| „ | .. | Hurun Pall ..... | Deep channel; 8 feet water, current not strong; no fall; fine bluff rocks in the middle of the river, one on either hand from the Pall. |
| „ | 0½ | ..... | Deep channel between rocks, 10 or 12 feet wide. |
| „ | 0¼ | ..... | Deep, narrow pool; slight current. |
| „ | .. | Hurun Pall Ghat.... | A fall of 6 feet in 30; passage 8 or 10 feet, with projecting pointed rocks on each side; very bad and dangerous. |
| „ | .. | ..... | 100 yards; rapid. |
| „ | .. | ..... | Fall 3 feet; not so bad as the first, but difficult, from the water dashing on a projecting rock on the right hand; channel 10 or 12 feet. |
| „ | .. | ..... | 100 yards; rapid. |
| „ | .. | ..... | Fall 4 feet; much like the above. |
| „ | .. | ..... | Deep channel below the rapids. |
| | | | *Left hand Channel from Hurun Pall.* |
| „ | .. | ..... | 300 yards; deep and clear. |
| „ | .. | ..... | Channel between rocks; deep and clear. |
| „ | .. | ..... | Channel between rocks; deep water. |
| „ | 0¾ | ..... | Fine deep, broad pool; no rocks. |

| Date. | Distance in Miles. | Names of Villages or Rapids. | Remarks. |
|---|---|---|---|
| 1848 April 23rd | .. | ..... | The bed of the river covered with low, sunken, and small isolated rocks; no regular channel; in some places 6 inches water over the rocks, and then suddenly deep. |
| „ | .. | ..... | No passage at all. |

At 10 A. M. returned to Dhurmray, and at 11 o'clock set sail for Chikulda with a fresh westerly breeze. Arrived at 3 A. M.

(Signed) R. H. FENWICK,
In charge of the Coal Fleet.

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From R. N. C. HAMILTON, Esq., Resident at Indore,

To J. G. LUMSDEN, Esq., Secy. to Govt., Bombay.

*Dated Indore Residency, 22nd May* 1848.

SIR,

I have the honour to transmit, for submission to the Right Honorable the Governor in Council, the annexed copy of a letter from Captain Fenwick, reporting his arrival at Broach on the 15th instant, with 48 Bengal maunds (about 1¾ ton) of coal.

By my despatch No. 538, dated 27th ultimo, His Lordship in Council was informed that a depôt of coal had been formed at Chikulda, below which the Nerbudda was not navigable on the 23rd of April.

Captain Fenwick, under instructions from me, procured two carts, with which, being laden, he proceeded to Kunnalee, on the Nerbudda, below Tullukwara. The road he found easy, and practicable for carts; and at Kunnalee, having procured boats, he continued his trip to Broach, the river being easily navigated in a boat of 36 maunds tonnage.

The coal has been delivered to the Collector, and Captain Fenwick will return to Chikulda, coming up in the boat in which Captain Evans went down last year, with a view to determine how high up the river above Kunnalee the Nerbudda is navigable at the season of its smallest depth of water.

Captain Fenwick will take the coal in store at Chikulda from thence to Broach as soon as the river is open, and the navigation safe, and thence to Bombay.

From all the information I have collected, I am satisfied that coal may safely be conveyed from Dharee to Broach between the months of August and

December, in any quantity for which there may be tonnage; but that between February and June the Nerbudda is not navigable.

As soon as a regular communication is opened, the return trade will go far to cover the cost of transit, as there would be a constant supply of goods to be brought up from Broach.

I have, &c.

(Signed) R. N. C. HAMILTON,

*Indore Residency, 22nd May* 1848. Resident.

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From Captain R. H. FENWICK, in charge of Coal,

To R. N. C. HAMILTON, Esq., Resident at Indore.

*Dated Broach, 16th May* 1848.

SIR,

This is simply to inform you that I arrived here yesterday, and to hand to you the accompanying receipt from Mr. Davies, the Collector. I am assured it will please you that the coal, which has been brought thus far, has been preserved, notwithstanding the cartage, shiftings, &c. I was advised by the Raja of Oodeypore to go from Chikulda to Kunnalee, instead of Tullukwara, as boats were not to be had there, and would have to be ordered up from Kunnalee at extra cost, and with the loss of two or three days; and besides, the distance to Kunnalee from Warna is less than to Tullukwara, owing to the reaches of the river. I met Mr. Mansfield, Political Agent Rewa Kanta, at Kunnalee, and received every assistance from him. Colonel Outram has acted in the kindest manner to me. He wished me to go to Baroda, but I may not do that just now. Mr. Davies aids me in every way. I could have taken the coal now here to Bombay, as I have been offered freight in a large pattimar which is just sailing out, but there is no object now. The boat brought down by Captain Evans is here; I am putting it in order, and shall take it up with me as far as the river will admit, and then I purpose travelling through the jungle to Chikulda. I hope the boats and boatmen will be ready to bring the coal down from that place as soon as the river fills. My hopes are getting up: but the river *must* be the channel for the coal down, and trade up. I shall be very anxious to go to Indore, and pay my personal respects to you. I could say more then than by writing volumes. The cost of boatage from Kunnalee to this has been Rs. 6 (Baba Shahee) per boat. One carried 36 maunds of coal, the other 12 maunds, myself, and my small baggage. Regarding the river from Kunnalee, I do not know how I could better describe it to you than by comparing it with the Bagheeruttee and Hooghly from Berhampoor to Calcutta. The money accounts I shall have the pleasure of submitting to you as soon as I have a little rest.

I have, &c.

(Signed) R. H. FENWICK,

*Broach, 16th May* 1848. In charge of Coal.

From G. A. Bushby, Esq., Secy. to the Govt. of India,
To A. Malet, Esq., Chief Secretary to Govt., Bombay.

Home Department. *Dated the 13th May* 1848.

Sir,

I am directed to acknowledge the receipt of your letter No. 679, dated the 26th ultimo, respecting certain coal-fields discovered near the river Nerbudda, and reporting the measures proposed by the Resident at Indore for working them, and the extent of aid already afforded by the Government of Bombay.

The experiment appears to the Governor General in Council to be a very expensive one, while the calculations on which it is based are so indefinite and inconclusive, that it is difficult to regard it with much confidence.

The Honorable the Court of Directors and the Supreme Government have long been desirous of ascertaining the real character of the coal mines lying near the banks of the Nerbudda; but as the services of Mr. Williams, the Geologist, could not immediately be made available for this purpose, the inquiry was of necessity postponed for a time. It is not stated in your letter whether Mr. Johnstone is qualified by geological attainments to pronounce a judgment on the point. It does not appear how the batch of coal sent to Dharee in March last is proposed to be conveyed to the coast; but Mr. Hamilton's own estimate of the cost of the coal per ton exceeds the price of English coal in the Bombay market.

Under all the circumstances of the case, so far as they are at present known, His Lordship in Council must hesitate to accord his sanction to the steps which are proposed to be taken by the Government of Bombay for the furtherance of Mr. Hamilton's plans: he would desire to be put in possession of more complete information on the subject; and I am directed to request, that pending further instructions no arrangements involving expense may be entered into, which are not of a temporary character.

I have, &c.
(Signed) G. A. Bushby,
Secy. to the Govt. of India.

*Fort William, the 13th May* 1848.

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From R. N. C. Hamilton, Esq., Resident at Indore,
To the Secretary to Government, Bombay.

*Dated Indore Residency, 29th August* 1848.

Sir,

I have the honour to state, for the information of the Right Honorable the Governor in Council, that Captain Fenwick reports having reached Broach by

water from Chikulda, with 239 sacks of coal, which have been lodged in a godown at the Custom House.

Copies of Captain Fenwick's letters are annexed; and his Journal, as soon as received, shall be forwarded. Considering the craft,—with two exceptions the common ferry-boat of the Ghauts,—it is not surprising that two were swamped.

I have never entertained any opinion of the Nerbudda as a navigable stream for commerce; yet many of the difficulties encountered by Captain Fenwick might have been lessened, and the passage of boats facilitated, had nautical science been brought to the aid of the experiment.

It may be assumed as a fact, that coal can be transported down the Nerbudda, proper precautions being taken, and suitable boats provided, although for the purposes of commerce the river is valueless.

Captain Fenwick will, I trust, be considered to have merited the approbation of Government for his exertions. He will return to Broach, and proceed to deliver the coal now there to the authorities at the Dockyard in Bombay.

I have, &c.

(Signed) R. N. C. HAMILTON,

*Indore Residency, 29th August* 1848. Resident.

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From Captain R. H. FENWICK, in charge of Coal,

To R. N. C. HAMILTON, Esq., Resident at Indore.

*Dated One Mile above Hamp, 3rd August* 1848.

SIR,

This is simply to inform you that we arrived here yesterday. I am now writing from on board, and beg you will excuse errors. We have met with serious misfortunes: we lost one boat below the Hurun Pall,—it was dashed against a rock in the middle of the channel, and we saw nothing more of it till the next day. Yesterday at this place two boats were completely lost, and a third just had time to land her cargo. I shall not fail to send you my Journal from Broach, the moment I arrive there, which I expect to do by the 6th. The Nerbudda from Hurun Pall to this I think impracticable for purposes of traffic. Some of the boatmen with me accompanied Captain Evans last season, and they say that the river was higher then than at present, and they did not meet with these difficulties. I cannot express to you my admiration of the boatmen, and I would trust myself with them always.

I have, &c.

(Signed) R. H. FENWICK,

*One Mile above Hamp, 3rd August* 1848. In charge of Coal.

From Captain R. H. Fenwick, in charge of Coal,

To R. N. C. Hamilton, Esq., Resident at Indore.

*Dated Broach, 9th August* 1848.

Sir,

I beg to acquaint you that I arrived here this morning at 8 o'clock, and immediately called on Mr. Davies, the Collector, who has kindly given me a room in his house, and godown at the Custom House for the coal, where it is now being deposited, and will be kept under my charge. I grieve to say we have lost 99 bags of coal. We met with another serious accident on the 5th instant, about three miles below the Mokree barrier. A boat which carried only 5 bags, with the Karkoon, and always brought up the rear, struck against a rock in the middle of the river, which is there about half a mile broad, and instantly filled. Luckily, the river was then subsiding, and it got fixed between two points. The boatmen swam ashore. The Karkoon was picked up by a boat pushed out for the purpose. The next morning the coal was taken out, and put on another boat, and the wreck brought off, and having been repaired, has been brought on here. It is necessary I should inform you that I believe there is not a single boat of the fleet that has not at one time or another been in danger, by being carried on rocks, or nearly swamped in the rapids, waves, or whirlpools. The large boat, the double boat, and the boat I was upon, have had narrow escapes. From all this, and the general character of the river between the Hurun Pall and the Mokree barrier, I am confirmed in the opinion that it is not a navigable stream, available for the purposes of commerce.

I have, &c.

(Signed) R. H. Fenwick,
In charge of Coal.

*Broach, 9th August* 1848.

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From Captain R. H. Fenwick, in charge of Coal,

To R. N. C. Hamilton, Esq., Resident at Indore.

*Dated Camp Chandore, 18th August* 1848.

Sir,

I have not written to you since my letter of the 9th instant, as I was anxious to settle with the boatmen finally before I did so. I now have to inform you that seven of the Mundlaisir boatmen having returned overland, refusing to serve for less than one rupee per diem each, I have left the large boat and the double boat at Broach, under the charge of the Collector. The boat which struck on the rock below the Mokree barrier was so much injured that it could not be kept afloat: I have left it also with Mr. Davies, and requested of him

to have it sold by public auction. This boat was an old one; but as I could get none other at Chikulda, and it being desirable that an empty spare boat should accompany the fleet, I brought it with me. The Karkoon with 5 bags of coal always brought up the rear in it.

Five of the Chikulda boatmen, and the boat brought down by Captain Evans last season, now form the fleet, which left Broach on the 14th instant, and I overtook it on the morning of the 16th at Jenore, the Collector having kindly lent me the Government bunder-boat to take me up so far. We arrived here this forenoon. We make very slow progress, although the river has subsided very much indeed. How we shall manage up the rapid I am unable to anticipate, nor can I guess in how many days we shall be able to reach Chikulda. This trip will, I trust, complete the experiment. I am not certain whether I shall be able to persuade the boatmen to come down with me again. I should like this very much, as I think I should make the voyage in six days. I shall not be afraid of the jungle fever until after the 15th of September. After my letter of the 9th instant, I have very little to say regarding the obstacles in the river between Hurun Pall and Mokree, and I am sorry that I shall not be able to send you my Journal before I reach Chikulda: but I may generally state in this place, that there was scarcely a mile of free navigation the whole way,—I mean at a stretch; and we encountered difficulties and dangers several times each day. I place the safety of the boats which escaped destruction to the skill, energy, physical strength, and cool courage and spirit of the boatmen, whose conduct I cannot sufficiently praise. I may almost say, though, that we trusted more to our being able to swim than to the boats, to reach Broach.

It may be necessary to detail here, for your information, the arrangements I made to run no risks needlessly, to ensure safety to the boats, and to meet all accidents, in as far as human foresight could effect it. I established order by nominating Muddun, the head Mundlaisir boatman, as chief, and Bholoo and Munnia of Chikulda his deputies. Each boat was named, and directed to sail in its proper place. My boat always took the lead, and, according to circumstances, kept two or three hundred yards or more ahead of the rest. The large boat followed; then the double boat; the rest in their proper order; the empty or Karkoon's boat bringing up the rear. I had a black, a red, and white flag on my boat. The red hoisted ordered the boats behind me to push to shore without a moment's delay to the left bank; the black to the right bank; and the white to follow in my track. Whenever we came to any difficult places, the boats were put to; the headman went overland to examine; after that my boat was passed over, and if the channel was found practicable, they returned and brought on the rest, my boat being kept in readiness below the barrier, rapid, or whirlpool, to pick up the men in case of a boat being lost. This precaution saved some of the boatmen at the rapid above Hamp, and the Karkoon below Mokree.

I have already informed you that we have lost 99 bags of coal: 239 bags

of the present batch, and 48 that I left with the Collector in May last, form the total quantity now in Broach. A circumstance which very much distressed me was, that although during the night we had awnings put up, and secured the coal from the rain, which fell more or less every day from the 29th July to the 7th instant, in the day-time it was taken down, the wind being from the westward, and the bags were unavoidably exposed to the constant showers; but more than that,—the spray from the waves at the rapids frequently dashed over the boat from head to stern, and drenched everything in it. There was no remedy against this. The coal in the boat which struck on the rock above Hamp, and had just time to land her cargo, was completely wetted. However, although much of the dust has been washed out of the bags, I believe the bulk of the coal has not been injured. You may conceive from the above what would be the fate of valuable articles of traffic in such boats as these.

I have, &c.

(Signed) R. H. Fenwick,
In charge of Coal.

*Camp Chandore*, 18*th August* 1848.

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From R. N. C. Hamilton, Esq., Resident at Indore,

To J. G. Lumsden, Esq., Secy. to Govt., Bombay.

*Dated Indore Residency*, 21*st September* 1848.

Sir,

In continuation of my letter No. 908, dated 29th ultimo, I have the honour to state, for the information of the Right Honorable the Governor in Council, that Captain Fenwick has arrived at Chikulda, having effected his return by water.

I beg to forward a copy of Captain Fenwick's Journal, which supplies some interesting particulars regarding the navigation of the Nerbudda,—a river which must now be pronounced not practicable for the purposes of commerce, though, with suitable arrangements and precautions, coal may be floated down during certain months of the year.

Should the Sonadeh coal-fields be worked, the coals must be lodged in depôts at convenient positions, and moved as circumstances will admit. I regret much that all my endeavours to find coal near Baug, or nearer the mouth of the river than Sonadeh, have hitherto failed.

I have, &c.

(Signed) R. N. C. Hamilton,
Resident.

*Indore Residency*, 21*st September* 1848.

## CAPTAIN FENWICK'S JOURNAL,

*Alluded to in the preceding Letter from* Mr. HAMILTON.

| Miles | Furl. | |
|---|---|---|
| | | *29th July* 1848.—Left Chikulda at 8 A. M. |
| 12 | 0 | To Dhurmrae; not a rock nor a ripple. |
| 1 | 0 | Hurun Pall; no rocks in the channel, nor any difficulty. |
| 0 | 0¼ | Enter the Bhorekeyree rapids. Had all the boats put to on the right bank, and taking with me four of the best boatmen, viz. Muddun, Bholoo, Munnia, and another, proceeded in my boat to examine the passage. |
| 1 | 0 | Bhorekeyree; channel at the narrowest part about 60 feet; very bad, from the high waves; the boatmen sent back for the rest of the boats; all shipped in water, the double boat the most. |
| 2 | 0 | River studded with bluff rocks, some of them several feet above water, some just under the surface. This is a very bad passage; the channel in some places 40 feet wide; waves very high; all the boats shipped in water. |
| 0 | 0½ | *Very very bad;* high waves; current very rapid; rocks everywhere, and with difficulty avoided. One of the boats got fixed on a rock in the middle; other boatmen had to swim to it, and it took some time to get it off. |
| 0 | 1 | Very bad rocks; the channel very winding, intricate, and dangerous. |
| 0 | 0½ | Rapid; very bad channel, studded with rocks; 30 feet passage; just below it a boat was dashed on a rock, and completely lost; 30 bags of coal gone. The boatmen swam ashore; a Bildar, who could not swim, was left on the rock during the night, and brought off the next morning; could not do it in the dark of the evening. |
| 0 | 0¼ | Put to, on rocks; no village. The fleet separated for the night; three boats got down a quarter of a mile; mine and two others below the rock and rapid, and three boats above it. |
| Total 18 | 0½ | miles by guess. |
| | | *30th July* 1848.—Put off at 8 A. M. |
| 0 | 0½ | Some rocks in the channel, and rapids; a very small pointed rock in the middle of the river, which widens here, and becomes free from danger; rocks on each hand. |
| 3 | 0 | Clear and deep; only two or three rocks visible; a huge barrier of rocks across from bank to bank; 30 feet channel near the right bank. This place is called *Kalee Kuree;* high waves; rather bad; no other practicable channel. At 300 yards a bad rock in the middle, under water, very dangerous; current very rapid, and rushing on it. |
| 1 | 0 | Isolated rocks all the way; channel not bad, being broad and deep near the left bank. |
| 1 | 0 | Clear and deep; bluff high rocks in several places; three channels, not difficult; the left hand one is the best. |
| .... | | A whirlpool, but not bad at present. |
| 1 | 0 | Clear. |
| .... | | A rapid; head of the Dupana barrier, and falls; dangerous rapids, from the channel not being well marked; very high waves for 400 or 500 yards. All the boats shipped in water except the large boat *Rewa-sunker;* the double boat the most. |
| 1 | 0 | A field on the right bank, belonging to Dupana. |
| 0 | 0½ | Dupana. |
| .... | | A rapid. |

| Miles | Furl. | |
|---|---|---|
| 0 | 0½ | High waves the whole way; rocks in the channel, which is 40 feet wide, 10 feet deep, as almost all the channels are just now. |
| 1 | 0 | Rocks the whole way, but passage not difficult or dangerous, being broad and deep. |
| .... | | A rapid, but not dangerous; deep water and good channel. |
| 0 | 0¼ | Bad rocks in the middle of the channel. |
| 1 | 0 | Not difficult. |
| .... | | A rapid for 300 yards; waves; a whirlpool, but not bad just now; rocks under water; channel broad and deep. |
| 1 | 0 | Deep water; rocks, immersed and isolated, all across; waves. The river has widened for the last two miles. |
| .... | | Bad rocks, some under water, some appearing; the channel near the right bank deep and good. |
| .... | | Kurhaee, on the left bank. Found the lost boat on a rock, one side smashed in altogether; totally useless. |
| 2 | 0 | Abundance of water. |
| .... | | Some rocks in the middle of the river, and near the right bank; passage wide, and easy ripple. |
| 2 | 0 | Deep and broad. |
| .... | | A huge rockish land on the right hand, at the confluence of the Hutnee river; low rocks on the left hand; passage broad and deep. |
| 2 | 0 | Clear and deep from bank to bank. |
| .... | | Village and cultivation on the right bank. |
| .... | | A bluff, long rock-island near the left bank; broad, clear, and deep stream on the right hand. |
| 0 | 0¼ | A long range of bluff rocks in the middle of the river; deep, good channels on either side. |
| 0 | 0¼ | A rock-island near the right bank; passage on the left hand. |
| 1 | 0½ | A barrier and rapid; rocks and waves across from bank to bank; channel on the left hand, near the shore, only 20 feet wide. |
| 0 | 0¼ | The head and first of the Bheetara barrier; falls and rapids *very very bad;* the river studded with low rocks from bank to bank, and apparently no passage. |
| .... | | Six bags of coal were taken out of the double boat this morning, and put on some of the others, *Rewasunker* taking 4 maunds more, making her cargo 5 manees and 10 maunds. |
| .... | | Put to at half-past 4 P. M., on rocks on the left bank, opposite Bheetara. |
| 20 | 0 | miles by guess. |

*31st July* 1818.

| | | |
|---|---|---|
| 0 | 0½ | Strong current; the boats let down with ropes, brushing along the sides of perpendicular precipices 20 to 30 feet high, along the left bank, the current rushing towards the barrier. The barrier or ridge of rocks extends for about 300 yards, studded with rocks, some just above the water, some under; no practicable channel. The boats were let down with ropes, and by the hand, knocking and bumping on the rocks the whole way, and in some places dragged over; 20 bags were taken out of *Rewasunker,* and carried over the rocks for about 150 yards. It and the double boat were taken over with much labour and difficulty, and we did not get over the work before 12 o'clock. This passage is very tedious, but not so dangerous, or attended with the same risk, as that below the Hurun Pall, for about 6 miles. *There* ropes cannot be used, nor punting be resorted to, and the oars are not powerful enough to command the boat through the winding channels; the current rushing on rocks on all hands. |
| 0 | 0½ | Pretty good. |

| Miles | Furl. | |
|---|---|---|
| .... | | *The Beytana Ghat Barrier.*—Rapids and falls. Put to on the right bank to examine them; forbidding and fearful. The main stream is on the left hand; *very, very, very bad* for 300 yards; high waves; almost a direct fall. Carried my boat over with four of the best boatmen to test it; the boat nearly filled. The laden boats could not have been taken down by this channel. Examined a narrow passage between rocks for 300 yards on the right bank. This is bad too, but there is no other; it is about 18 feet wide. All the Chikulda boats were lightened of 12 maunds each; *Rewasunker* 13 maunds; and the double boat 24 maunds;—the two latter, and two of the Chikulda largest and best boats, were taken down the left or main channel, and four of the latter by the narrow one. The latter were managed with bamboos, the former with oars and paddles. Ropes cannot be used here. All shipped in water, and the double boat, as usual, a good deal. The right hand channel is dangerous, from not being more than 18 feet wide, with pointed, projecting rocks on either hand. In one place the waves here too were very high,—almost a direct fall; the water several feet deep. The coal, which was landed, was carried over the rocks for some 500 yards. |
| 1 | 0 | Put up on the rocks on the right bank, a little below the village of Beytana, and the rapids; the boatmen being knocked up, and it being late. |
| 2 | 0 | miles by guess. |

*1st August* 1848.—Left from below Beytana at 7 A. M.

| | | |
|---|---|---|
| .... | | The river has fallen about 2 feet since yesterday evening. Leaving the rest of the boats moored, I proceeded in my boat with Muddun, Bholoo, Munnia, and others, to examine the passage below, which appeared to be full of rocks and rapids. |
| 1 | 0 | At 300 yards there is a pointed rock in the middle of the passage, badly situated just above the surface, the current rushing on it with great force; deep water, rocks, and rapids the whole way; channel not well defined. My boat was put to, and the boatmen sent back for the others. |
| 1 | 0 | Hailkuree; a gut or strait between perpendicular, precipitous cliffs, 20 and 30 feet high; near the right bank deep water and slight current. Width 70 or 80 yards; a very remarkable passage. |
| 0 | 0½ | High rocks on either hand; channel about 150 yards or so; deep water; a bad place for whirlpools, as the villagers say. |
| .... | | Surkuree, on the right bank. |
| .... | | Surkuree barrier, and rapid, called *Gulchee Ghat*, or *Tur. A very, very, very bad* passage; rocks across from bank to bank, some just above the water, some under; the latter are the worst. Only one difficult channel, in the middle, about 40 feet wide; deep water; current rushing; half the day lost in bringing the boats over. |
| .... | | For 100 yards channel from bank to bank; then rocks; a whirlpool; and then a very deep pool; a deep broad pool; a formidably large whirlpool, dangerous. A single mango tree on the left bank points out the spot. |
| .... | | At 400 yards the village of Sudree, on the left bank; a broad, deep pool. |
| .... | | At 300 yards a rapid; broad channel in the middle of the river; on either hand very bad rocks. |
| .... | | A village just below, on the right bank; a little cultivation on either hand. |
| 0 | 0½ | Deep pool; several isolated rocks; channel deep and broad in the middle. |

| Miles | Furl. | |
|---|---|---|
| .... | | Rocks and ripples. |
| 0 | 0¼ | For first 300 yards broad and deep channel on the left hand. |
| 0 | 0¼ | Deep pool. |
| .... | | Rocks on the right hand; a rock-island, channel on each side. |
| 0 | 0½ | A pool. |
| .... | | A bad rock in the middle, just above the water, and very little ripple to denote it. |
| .... | | A village on the left bank; a deep pool; rocks on the right hand. |
| .... | | Fields on the left bank. |
| 0 | 0¾ | Clear. |
| .... | | Rocks on the right hand. |
| 0 | 0½ | Nanka Ghat, barrier, rapids, &c.—*Very, very, very bad.* The boatmen compared it to Sahesur Dunah. I examined the largest channel, which is in the centre, in my boat, and found it fearfully obstructed with rocks, rapids, rushing current, and their attendent perils; waves peculiarly high, and little whirlpools or eddies; the water swelling, and curving over the rocks, and then falling headlong into a deep trough. All this extends for a quarter of a mile. *Rewasunker* was dashed against a rock, and nearly lost. Luckily none of the laden boats came down by this channel; signals were made in time to prevent them. They took to the left bank, and came through another passage above the shore; shallow, with rocks and waves, but nothing to be compared to the other. Put to at sunset, below the falls, on the left bank; Selukda village on the right bank, Gunnoo Patel. |
| 5 | 0¼ | miles by guess; I think it must be something more. |

*2nd August* 1848.—Left at 6 A. M.

| | | |
|---|---|---|
| 1 | 0½ | A deep pool. |
| .... | | A bad rapid; channel near the left bank. |
| 0 | 0½ | A very bad rapid and whirlpool; obliged to use ropes. |
| 0 | 0½ | A pool. |
| .... | | A very bad rapid; high waves; passage along the left bank. |
| 1 | 0¼ | Rocks, rapids, and high waves; a very bad passage. I came down in my boat by the left hand channel, which we found not practicable for the laden boats; sent back the boatmen to bring them down by the right hand channel, which is very shallow. |
| 0 | 0¾ | Deep sliding current; clear channel. |
| .... | | Put to, to examine below; rocks everywhere; one of the boats, the *Pundit*, struck on a rock, and was nearly lost. |
| .... | | The village of Chipna on the right bank. |
| 1 | 0½ | Half the way clear; then bad rocks, rapids, and high waves. As usual, I took my boat down with Muddun, Bholoo, Munnia, and others, to examine the passage. Found *this one* not practicable for the laden boats. The channel to the right was selected, and they went back for them. To prepare for accidents, I had my boat ready below the rapid in the worst place; ropes could not be used. There is a whirlpool under the fall or rapid. One of the laden boats first coming down, struck on the rock in the middle, and at the head of the channel, but got off, and was enabled to reach the shore, and land the coal, before it filled. Shortly afterwards two boats, although they avoided the rock, were dragged into the rapid and waves, swamped, and went down bodily; nothing more seen of them. Some of the boatmen swam ashore, some were picked up by my boat; one young man got into the whirlpool, and we gave him up for lost; fortunately he got hold of an oar, and being an expert swimmer, |

| Miles | Furl. | |
|---|---|---|
| | | landed himself low down. One of the two latter boats, being under water for some time, rose again to the surface, almost erect, in the centre of the whirlpool, and was brought to land. All this happened in the evening, one mile above Hamp. |
| .... | | 61 maunds or bags of coal lost to-day; some of the Bildars and several of the boatmen have lost everything they had,—pots, pans, clothes, &c. This morning, when leaving Selukda, the following arrangements were made, and ordered accordingly:—Muddun was appointed chief, Bholoo and Munnia his deputies. My boat was to lead at 200 or 300 yards, or more, in advance, according to circumstances; *Rewasunker* to follow; then the *Saugur* or double boat. The rest were named too, and to come next according to their appointed order. The Karkoon's boat, with only 5 bags of coal, was to bring up the rear. A red, a black, and a white flag were kept to my boat, to make signals: on the red being hoisted, all the boats were to pull ashore to the left bank instantly; the black pointed to the right bank; and the white directed to follow my boat. |
| 6 | 0 | miles by guess. |

*3rd August* 1848.—Left above Hamp at 9 A. M.

| | | |
|---|---|---|
| .... | | The two boats were repaired, 13 bags of coal put on board the small one, and 23 bags on the other, and 7 bags were taken in my boat; the *Saugur*, or double boat, was also considerably lightened. |
| 1 | 0 | A deep pool. |
| .... | | A bad rapid; rocks just above the water, in the middle. |
| .... | | Bhuroorgan on the left bank. |
| 2 | 0 | A strong current and whirlpool. |
| .... | | *Bhalagooree*, called *Bygee-ka-Phur*.—A very narrow passage; high rocks on each hand; a very bad and dangerous whirlpool; very high waves; some of the boats had narrow escapes. |
| 1 | 0 | A narrow passage; huge rocks on either hand; stopped here for two hours, and sent on boatmen to examine the rapid and passage below. |
| 0 | 0¼ | A very bad channel near the left bank; a bluff rock-island. |
| 1 | 0 | A bad rock in the middle of the channel; high rocks; on each hand a whirlpool. |
| 2 | 0 | Strong current; a whirlpool; a rapid; two rocks in the middle; high waves. |
| 0 | 0½ | Rocks; rapid and waves; a very bad and difficult passage. |
| .... | | Peepul Chope on the left bank. |
| 1 | 0 | Put to at 5 P. M., on the left bank; half of the boat which was lost yesterday found here. |
| 8 | 0¾ | miles by guess. |

*4th August* 1848.—Left below Peepul Chope at 7 A. M. The river has risen a good deal.

| | | |
|---|---|---|
| 1 | 0 | Stream rapid and broad. |
| .... | | A rock-island on the right hand. |
| 0 | 0½ | Rocks in the channel; a rapid, and waves. |
| 0 | 0½ | The same as above. There are two channels here; some of the boats came down by the right hand one, and some by the left passage; the latter is the worst. |
| 0 | 0½ | Clear. Put to, to examine below. |
| .... | | Rocks, and strong current in the channel. |
| 1 | 0 | A rapid; rocks on the right hand. |
| 1 | 0 | A rapid; rocks on the left hand; cultivation along the right bank; teak trees. |

| Miles | Furl. | |
|---|---|---|
| 0 | 0½ | A bad rock on the right hand ; the current rushing on it. |
| .... | | A village on the right hand. |
| .... | | A rapid, and high waves. |
| 0 | 0½ | A bad rock in the channel ; a rapid; high waves; two date trees on the left bank ; cultivation. |
| ..... | | A large, bad whirlpool. |
| 0 | 0¼ | Put to, to examine the rocky passage below. |
| 0 | 0¼ | Strong current ; a rapid; very bad rocks in the middle of the channel ; bamboo bushes begin to appear. |
| 0 | 0½ | High rocks almost across the river ; put to on the right bank, to examine the passage ; channel along the left bank not bad. |
| 2 | 0 | Clear channel along the right bank and middle ; very strong current. |
| .... | | A village on the left bank ; river rising. |
| 0 | 0¼ | Rocks in the middle of the channel ; put to, to examine, and allow the boatmen to take their breakfast. |
| 1 | 0 | Rocks, rapids, waves; very bad. My boat was dashed against a small pointed rock in the middle of the channel ; it filled partially, heaved, swung round, and plunged into the trough and waves below, but got out again ; a laden boat would have gone down. |
| .... | | Put to, to examine below. |
| 0 | 0¼ | A very bad rock, and below it a whirlpool ; very formidable ; almost all the boats got into it, were taken round and round for several times, dashed against each other, and got jammed in the vortex for a minute or two. |
| 0 | 0¼ | Bad rocks and rapids ; river still rising. |
| 0 | 0¼ | Very bad whirlpools, waves, &c. |
| 0 | 0¼ | A very bad rock in the middle of the channel, and a strong current rushing on it ; very dangerous. |
| .... | | Put to, to examine the channel below. |
| 0 | 0¼ | A rock on the right hand, of no consequence. |
| 0 | 0½ | Beautiful plantations, along the right bank, of palms, mangoes, and mahwa trees, and cultivation, interspersed with huts, the whole way. Two bad rocks in the middle of the stream. |
| 0 | 0½ | Rocks in the middle ; strong current ; plantations continued along the right bank, belonging to the village of Guddair. |
| 1 | 0 | Clear, broad stream ; put to, to examine a rapid below. |
| .... | | Strong current ; rocks on either hand, but not dangerous ; river still rising slowly. |
| 1 | 0 | *Very, very bad* rocks ; a rapid and whirlpools ; Surpon barrier, &c. |
| .... | | Sulpon or Surpon ; Mahadeo temple on the left bank. Put to under Surpon at 5 P. M. |
| 14 | 0 | miles by guess ; it may be something less. |
| | | *5th August* 1848, 8 A. M.—At Surpon ; boatmen attending the temple. The river has risen a little during the night ; heavy rain all night, and now continued. Put off at 9 A. M. Took another boatman on my boat to-day, having hitherto had only three. |
| .... | | Rocks on the left hand, to be avoided ; strong current. |
| 0 | 0¼ | Rocks on the right hand ; current strong. |
| 0 | 0¼ | Rocks ; a rapid ; caution required ; dangerous waves, and a bad whirlpool. |
| 0 | 0¾ | Rocks on each hand ; channel good. |
| .... | | A pagoda on the right bank. |
| .... | | A village on the left bank ; palms, mango trees, cultivation, and huts along the right bank. |

| Miles | Furl. | |
|---|---|---|
| 2 | 0 | Rapids, currents, and rocks, but not bad. |
| .... | | Commencement or head of *Mokree Ghat Phal Tur*, or barrier, falls, &c. |
| .... | | Put to, to examine the passage; huts, palms, &c. along the right bank. |
| .... | | Rocks all over and across the river; channel in the middle, 40 or 50 yards wide; very strong current, and high waves. |
| 0 | 0¼ | Clear. |
| .... | | Strong current; a rock on the right hand; channel along the left bank. |
| 0 | 0¼ | Strong current the whole way; very bad rocks in the middle; channel near the left bank. |
| .... | | A whirlpool in the middle; rather formidable; current rushing towards rocks on the right hand; very dangerous; numerous eddies, or little whirlpools. |
| 0 | 0½ | Mookur village on the left bank. |
| .... | | Rocks, rapids, waves, whirlpools; all very bad. |
| .... | | A large, huge rock-island in the middle; my boat took the less channel, which proved to be very bad and dangerous; whirlpools, waves, strong current, &c.; all very formidable. We thought ourselves in peril for a while; the boat was whirled and spun round and round, nearly filled by the waves, and was dragged towards some rocks on the right hand, and just escaped by a few feet from being dashed to pieces. The boatmen, especially Bholoo, showed great energy and presence of mind, and expertness on the occasion. This coolness was complete, unmoved by the imminent danger: with a few last strokes of the paddle, he kept the head of the boat off from a rock, which we expected it would be impossible to avoid. Put to on the left bank. All the other boats were *carried; forced* into the right hand channel, which luckily proved to be not so bad, got down safely, and put to on that bank. |
| .... | | River studded with rocky channels; current rushing through them, with sluice forces, *all very bad*. It took some time to make a selection, by trying an empty boat over some of them. I consider this Mokree barrier as one of the very worst in the Nerbudda. I had a good view of it, and the river, for two miles or so, above and below, from a high rock, and it certainly looked quite frightful. The boatmen think the river half full, and say that it was higher when Captain Evans went down last season. The Karkoon's boat was first taken down; the boatmen returned, and carried over three others, with six men to each, and so got the whole down safely. My boat came into the right hand channel with a great deal of difficulty. |
| 0 | 0½ | *Very, very bad rocks;* a rapid and a whirlpool at the bottom of the channel; all the above from the upper part of the Mokree falls, &c.; there is a *worse* passage yet below. At 2 P. M. all the boats arrived below the above whirlpool, and put to on the right bank. |
| 0 | 0¼ | Strong current,—*a torrent;* rapid waves, &c. along the left bank, and in the middle. No boats could possibly live there just now,—and this is the *main channel*. The boats were let down with ropes along the rocks, and over shallows on the right bank,—tedious work. The main channel or stream on the left, above alluded to, is studded with destructive rocks, the waves raging and lashing over them in spray and foam; numerous little whirlpools or eddies moving down in circular sweeps, and bubbling up from the bottom with a roar. From nearly the middle of the river to the right bank there are bluff rocks, with narrow passages of 10 and 12 feet, with little falls of 2 and 3 feet, and then suddenly deep. |
| 0 | 0¼ | Along the left bank the *torrent passage* continues worse than ever; nothing could live in it. |

| Miles | Furl. | |
|---|---|---|
| .... | | Neemrell on the right bank. |
| .... | | Thonia on the left bank, abreast of the worst part of the channel. |
| .... | | Just below there is *the fearful whirlpool:* it embraces the whole bed of the river, and I think we have scarcely encountered anything so awful and terrific. The boats were let down with ropes along the rocks on the right bank, still with much apprehension, for had they come within its influence nothing could have saved them. I take the river at this place to be between 300 and 400 yards wide, or more. |
| 0 | 0¼ | Rocks on either hand. |
| .... | | For 400 yards strong current, eddies, and little whirlpools. |
| .... | | Deep pool; no rocks in the river: the hills are receding; villages, cultivation, plantations, and topes of palms and other trees; all the signs of civilization, and of a thriving people, are here exhibited on both banks of the river. |
| .... | | Fine broad, still pool. |
| 0 | 0½ | Last of the hills on the left bank. |
| 2 | 0 | Pool; a noble stream. |
| 1 | 0 | Current and waves; sunken rocks, dangerous from their not being visible. |
| .... | | A pagoda on the right bank. |
| 0 | 0½ | Rocks and rapids; dangerous, from the rocks not being seen, but immediately under the surface. |
| 0 | 0½ | Put to at Emrio, on the right bank, Rajpeepla Ilaqua, at 6 P. M. Just at this moment the empty boat with the *Pundit* struck on a rock half a mile above, filled, and got fixed; luckily the river is falling. Took my boat with seven selected boatmen,—Muddun, Bholoo, Munnia, Gylia, and others,—and after great exertions got up to the rock, when it became completely dark. In trying to approach it near enough to throw over a rope, we found it could not be done,—the current dashed us away past it; and we were obliged to leave the Karkoon and three boatmen to their fate for the night, relying upon the river not rising, in which case they would be quite safe. However, to provide against everything, I had one of the boats emptied forthwith, and kept ready to pick them up, in the event of the boat floating off the rock. At this moment (it was pitch dark) we heard a shout, and soon after the voices of persons in the water, and shortly after all the four landed safely where we had put to. The boat having missed him, the Karkoon, too, had managed to reach the shore, with the help of a couple of bamboos lashed together, but he was nearly exhausted. The rock is in the middle of the river, and the stream here is half a mile or more broad. |
| 10 | 0½ | miles by guess. |
| | | *6th August* 1848.—The boat was brought off from the rock this morning. |
| .... | | Left Emrio at 10 A. M., having repaired the boat as well as we could; but it is quite shattered, and will barely keep afloat. |
| 1 | 0 | Rocks in the middle; a pagoda on the right hand; small sunken rocks, and ripples over them, on the right. |
| 1 | 0 | Gurhasur, on the right bank; a Gurhee on the top of a small hill, and a pagoda at the foot; some sunken rocks and ripples along, and near the right bank. |
| 1 | 0 | Aktesur pagoda on the right bank. Nothing to remark; not a rock nor a ripple; smooth stream from bank to bank. Arrived at Chandore in the evening, and put up in an old house of the Guikwar's. |
| 3 | 0 | miles by guess. |

| Miles Furl. | |
|---|---|
| | *7th August* 1848. |
| .... | Left Chandore at sunrise, and arrived at Leehrah or Lillore at 5 P. M., on the right bank. |
| | *8th August* 1848. |
| .... | Left Lillore at 4 A. M.; inspected the Kubeer Bar, or Mohmit's island; put to on an island at 4 P. M. |
| | *9th August* 1848. |
| .... | Left island at 6 A. M., and reached Broach at 8 A. M. |

*Chikulda, 15th September* 1848. (Signed) R. H. FENWICK.

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From Captain R. H. FENWICK, in charge of Nerbudda Coal,

To A. MALET, Esq., Chief Secy. to Govt., Bombay.

*Dated Bombay, 24th October* 1848.

SIR,

I have the honour to enclose, to be submitted to the Right Honorable the Governor in Council, the original receipt from the Indian Naval Storekeeper's Office, dated the 23rd instant, for 11 tons and 10 cwt. of Nerbudda coal, delivered at the Coal Depôt.

I have also the honour to forward extract of an official letter of instructions from the Resident at Indore, furnished to me under date the 20th July 1848; and to solicit that you will do me the favour to obtain for me the orders of His Lordship in Council for my future guidance.

I have, &c.

(Signed) R. H. FENWICK,
In charge of Nerbudda Coal.

*Bombay, 24th October* 1848.

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*Extract from a Letter of Instructions from the* RESIDENT AT INDORE, *under date the 20th July* 1848, *to* Captain R. H. FENWICK, *in charge of Nerbudda Coal.*

Para. 3. On arrival at Bombay you will make over the coal to Mr. Johnstone, or to the Steam Factory at the Dockyard, or to such other department as Mr. Johnstone may point out.

Para. 4. Having delivered the coal at Bombay, you will have the goodness to report to the Secretary to the Government in Bombay, and having done so, solicit the further orders of the Right Honorable the Governor in Council; reporting to me your proceedings.

(A true extract)

(Signed) R. H. FENWICK,
In charge of Nerbudda Coal.

From R. N. C. HAMILTON, Esq., Resident at Indore,

To Lieut. Col. P. M. MELVILL, Secy. to Govt., Marine Dept., Bombay.

*Dated Indore Residency, 9th November* 1848.

SIR,

I have the honour to acknowledge the receipt of your despatch No. 1604, dated 24th ultimo, and in reply to furnish a statement of charges and expenses on account of the coal experiment.

I have endeavoured to classify the several disbursements; but it is impossible to give them with that exactness which could fix the actual cost of raising and transporting a ton of coal, because a variety of charges have been incurred, as will be seen in the following abstract:—

| | | | |
|---|---|---|---|
| On account of Mr. Johnstone's pay ..... Rs. | 1,390 | 0 | 0 |
| Ditto of Captain Fenwick's pay ..... | 1,650 | 0 | 0 |
| Ditto of survey of the Nerbudda ..... | 400 | 4 | 11 |
| Expended by Captain Evans in purchase of sacks, &c..... | 177 | 1 | 0 |
| The cost at the pits for workmen, &c..... | 1,494 | 6 | 6 |
| The cost of transport ..... | 1,960 | 5 | 3 |
| Making a Total of.... Rs. | *7,498 | 7 | 8 |

There has been a greater expenditure in river transport, owing to the utter ignorance of all parties of the nature of the obstacles to be surmounted, and the total want of other means of transport than the common ferry-boat of the river: the novelty of the trip; its supposed danger; the dread of the jungle at its unhealthy time; and the unwillingness of the ferrymen to go beyond their usual beats, caused a higher rate of wages to be demanded, and to be allowed, than otherwise would have been admitted.

The fact that the coal can be raised at Sonadeh, and transported to Bombay, has, however, been established; and it is for the Government to determine whether a system of storing in depôts could not be adopted, so as to secure a supply of coal for the service of the steamers at any time it might be required.

In my letter No. 438, dated 31st March last, an estimate of the cost of raising coal is given. Contracts could be made with Bunjaras at a slight advance on the usual rates of hire.

The rate now charged by Bunjaras for the transport of grain or salt at the principal mart of Seonee, near Hurda, is 5 Nagpore rupees per 100 kos per manee of 6 maunds of 40 seers each, or about Rs. 20 a ton for 200 miles of distance; and supposing Bunjaras to be employed to convey the coal to Bombay by land, it would cost on delivery near Rs. 50 the ton.

But coal might be raised at the pits in any quantity, and stored at a convenient spot near the pits, so as to be ready at any time for removal; and

* This amount should be Rs. 7,072-1-8.—*Editor.*

this would not cost more than 12 annas per ton for raising, covering in, and making secure from the severity of the weather.

With reference to the sanction of Rs. 10,000 contained in your letter No. 544, dated 4th April last, I beg that the enclosed bill may be passed, that the accounts of this experiment may be finally adjusted, and charged in the public accounts.

I have, &c.

(Signed) R. N. C. HAMILTON,

*Indore Residency, 9th November* 1848. Resident.

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From the Honorable the COURT OF DIRECTORS FOR AFFAIRS OF THE HONORABLE EAST INDIA COMPANY, London,

To the GOVERNMENT OF BOMBAY.

*Dated 8th November* 1848.

OUR GOVERNOR IN COUNCIL AT BOMBAY.

We have read with much interest your letter No. 48, of the 25th April last, and its accompaniments, relative to the experimental operations in progress for obtaining coal from the Valley of the Nerbudda.

It appears that Mr. Hamilton, the Resident at Indore, under whose direction these operations are carried on, has ascertained that beds of coal exist at two places in the Baitool district,—at Sonadeh, where the seam is 20 inches thick, and at Mardanpore, where the coal is of better quality, and where the seam is 2 feet 4 inches thick. With the aid of Mr. Johnstone, who is described as a steam engineer of the Dockyard, whose services have been placed temporarily at Mr. Hamilton's disposal, 20 tons of the Sonadeh coal were procured and sent to Tullukwara, on the river bank, whither they were expected to be conveyed at an expense of Rs. 21 per ton, and where it was intended to ship them for conveyance to Bombay.

Mr. Hamilton estimated that the expense of working one shaft for twelve months would be Rs. 6,364, and that the return would be 10,920 tons of coal; and you have authorised him to expend Rs. 10,000, in order to test fairly the advantage of working the mine. If more than an experiment be intended, and if it be desired to work the mines with the view of supplying the Government demand for coal, Mr. Hamilton recommends that Mr. Johnstone be appointed to superintend the operations, with a salary of Rs. 600 per mensem for two years certain; that other appointments be made, raising the total cost of local superintendence to Rs. 1,000 per mensem; and that to every shaft that may be sunk, be attached an establishment of miners, &c., at an expense of Rs. 522 per mensem.

On the more important of these proposals you have expressed no opinion, further than by recommending Mr. Hamilton to confine himself for the

present "to feeling his way"; but you strongly urge us to permit Mr. Johnstone's services to be devoted to coal-mining for the period mentioned.

We are, however, not prepared to consent to this arrangement, which will divert for so long a period, from his immediate professional occupation in the Dockyard, the services of Mr. Johnstone, the Foreman of the Pattern-makers in the Bombay Steam Foundry, whence, as reported to you by the Superintendent of the Indian Navy, he can "ill be spared," and whither, consequently, he ought to return as early as practicable.

Still it is very desirable to ascertain the extent, value, and accessibility of the coal-fields of the Nerbudda Valley; and we approve of all you have hitherto done for the investigation of those questions. Unless, however, the experiment now being made should turn out much more favourably than there is at present reason to expect, it will afford little encouragement to adopt more extensive operations. The quality of the coal already discovered may be ascertained from the quantities which have by this time reached Bombay; and if it should prove to be as good as Mr. Johnstone imagined, the mines yielding it may become a valuable resource at some future period. But unless the cost of the carriage has been greatly overrated, or can be greatly reduced, coal can at present be obtained much more cheaply from other quarters. The conveyance from Sonadeh to Tullukwara alone, without counting the expense thence to Bombay, is reckoned at a sum equal to 42*s.* per ton, whereas the average contract price of coal purchased by us in England, and delivered at Bombay, including all charges, during the last three years, has been 32*s.*

It appears, therefore, that instead of immediately proceeding to work the mines of the Nerbudda Valley, the first thing to be considered is how the cost of conveyance can be reduced,—whether by the discovery of mines near the navigable portion of the river, or by the improvement of the roads to the mines already discovered.

We some time ago suggested that Mr. Williams, the Geological Surveyor, should be deputed to examine the coal-fields of the Nerbudda Valley. We observe that you have very properly communicated to the Government of India the proceedings and views reported in your present letter to us; and it may be proper for you also to inquire of the Supreme Government when it is probable that the services of Mr. Williams will be able to be spared for the purpose above mentioned. A survey of that gentleman would afford the means of judging whether it would be expedient to adopt any ulterior measures; but for the present it will be advisable to suspend operations, unless further information should warrant a more active course.

We are, &c.

(Signed) J. L. Lushington,
And other Directors.

*London, 8th November* 1848.

From R. N. C. HAMILTON, Esq., Resident at Indore,

To Lieut. Col. P. M. MELVILL, Secy. to Govt., Marine Dept., Bombay.

*Dated Camp Bairsiah, 19th December* 1848.

SIR,

Since my despatch No. 454, dated 9th November last, submitting the charges incurred in the coal expenses, I have seen Captain Fenwick, and learnt from him that the actual cost of conveyance of the coal from the pits to Bombay was as follows:—

| | | | |
|---|---|---|---|
| From Sonadeh to Dharee on the Nerbudda, by Bunjara bullocks ..... Rs. | 0 | 6 | 0 |
| By water contract to Chikulda ..... | 0 | 4 | 0 |
| Ditto to Broach ..... | 0 | 8 | 0 |
| By sea to Bombay (total hire Rs. 70) ..... | 0 | 4 | 0 |
| Making a Total of ..... Rs. | 1 | 6 | 0 |

per maund, or Rs. 38-8-0 per ton.

2. Captain Fenwick states the boat on which the coal was laden at Broach for Bombay was of tonnage sufficient to have taken more than double the quantity of coal, and that the charge from thence to Bombay would not exceed 2 annas a maund: this rate would reduce the cost to Rs. 35 per ton.

3. To this being added the cost of raising the coal, which may be put down at a rupee the ton, we have the total charge to Bombay at Rs. 36 the ton.

4. If it be intended to have any quantity of coal raised for storing, I hope to be favoured with instructions at an early date, the healthy season for work having commenced. Without being hurried as to time, knowing what is required, where difficulties will have to be encountered, and what are the resources available, arrangements can be made by which the cost may be reduced, and, it is to be hoped, the coal-fields of the Nerbudda made available for our sea-going steamers.

5. In my former letters, I mentioned that a commencement had been made in sinking a shaft: the work was closed on the setting in of the rains, after the shaft had been sunk 35 feet. It is highly desirable to persevere in this work, and I hope His Lordship in Council will sanction an expenditure not exceeding Rs. 400 on this account, as it is expected the coal vein may be reached at between 70 and 80 feet from the surface.

6. I beg to annex a statement of the average cost of coal for the use of the Dockyard since 1844, which was furnished to me by the late Superintendent of the Indian Navy.

I have, &c.

(Signed) R. N. C. HAMILTON,
Resident.

*Camp Bairsiah, 19th December* 1848.

*Statement exhibiting the Rates of the several Tenders for the Supply of Coal to the Indian Navy received between August* 1844 *and December* 1847.

| Date. | Quantity | Description. | Rate. | Remarks. |
|---|---|---|---|---|
| 1844 | Tons. | | | |
| August.... | 485 | Hard Splint Coal.. | 13 0 0 per ton. | Delivered alongside. |
| 1845 | | | | |
| March .... | 350 | Newcastle..... | 30 0 0 „ | Delivered free of charges. |
| „ .... | 600 | ..... | 28 0 0 „ | Ditto ditto. |
| April..... | 100 | ..... | 30 0 0 „ | Delivered alongside. |
| May..... | 70 | ..... | 30 0 0 „ | |
| „ ..... | 20 | ..... | 28 0 0 „ | |
| October.... | 644 | ..... | 18 0 0 „ | Delivered alongside. |
| „ .... | 325 | ..... | 18 0 0 „ | Ditto ditto. |
| December.. | 599 | ..... | 16 8 0 „ | Ditto ditto. |
| 1846 | | | | |
| January .. | 510 | Hard Splint..... | 18 0 0 „ | |
| April .... | 200 | Ditto ..... | 16 8 6 „ | Delivered at the depôt. |
| July..... | 150 | Carr's Hartley.... | 12 0 0 „ | Delivered alongside. |
| September.. | 405 | West Hartley .... | 14 0 0 „ | Ditto ditto. |
| October .. | 100 | Carr's West Hartley | 14 0 0 „ | Ditto ditto. |
| November.. | 300 | Ditto .. | 14 0 0 „ | Ditto ditto. |
| 1847 | | | | |
| January .. | 70 | Hotspur Steam .. | 13 0 0 „ | Ditto ditto. |
| December.. | 355 | Glasgow ..... | 16 0 0 „ | Ditto ditto. |
| „ .. | 50 | Coking..... | 16 0 0 „ | Ditto ditto. |

(Signed) JOHN CROFT HAWKINS, Commodore Commg.,
Officiating Superintendent, I. N.

*Superintendent's Office, Bombay,* 18*th September* 1848.

(True copy)
(Signed) R. N. C. HAMILTON,
Resident.

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From Captain J. C. HAWKINS, I. N., Commodore Commanding,
Officiating Superintendent, Indian Navy,

To the Right Honorable LORD VISCOUNT FALKLAND,
President and Governor in Council.

*Dated* 30*th December* 1848.

RIGHT HONORABLE SIR,

With reference to Secretary Lieutenant Colonel Melvill's letter No. 1603, of the 25th October last, requiring a full and final report upon the specimens of coal received from the Valley of the Nerbudda, I have now the honour to

report to your Honorable Board, that 5 tons of the coal in question were put on board the steam-vessel *Medusa* for trial, and herewith beg to submit a letter from the Commander of that vessel, giving the result of the test, from which it will be seen that the coal is not of a description adapted for consumption on board steam-vessels, although in emergency it might be used.

I have, &c.

(Signed) J. C. HAWKINS, Commodore Commg.,
Officiating Superintendent, Indian Navy.

*Superintendent's Office, Bombay, 30th December* 1848.

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From Lieutenant H. W. GROUNDS, I. N.,
Commanding the H. E. I. Co.'s Steamer *Medusa*,

To Commodore JOHN CROFT HAWKINS,
Officiating Superintendent, and Commanding the Indian Navy.

*Dated the 28th December* 1848.

SIR,

In forwarding the accompanying Report on Nerbudda coal shipped on board the *Medusa* for trial, I have the honour to inform you that a strict and careful investigation has been made to prove its qualities.

The large amount of earthy particles in the coal, which being purely incombustible, leaves a large quantity of clinker and dirt, in proportion of 58 to 1 of British coal, as will be seen by the annexed form; and as the clinker formed by it is of a soft form, spreading over the entire surface of the bars, thereby stopping all draught, I would respectfully beg to represent that the general use of it in marine purposes will be found to give but little or no favourable result, as it is almost impossible to keep steam up, even with the throttle-valve quarter open, and this as proved in the *Medusa*, whose draught is generally very favourable.

I have, &c.

(Signed) H. W. GROUNDS,
Lieutenant Commanding.

*Bombay Harbour, 28th December* 1848.

*Report alluded to in the preceding Letter, on Nerbudda Coal, as tried on board the Honorable Company's Steamer* Medusa, *December* 1848.

| | British Coal. | | Nerbudda Coal. | | Remarks, 26th and 27th December 1848. |
|---|---|---|---|---|---|
| Time taken to get up steam. | From 1 to 1¼ hour ..... | | 1¾ hour. | | |
| Weight of one bucket of coal ..... | 102 lbs. | | 92 lbs. | | Both small coal. |
| Weight of the same bucket again filled. | 98 lbs. | | 91 lbs. | | Ditto ditto. |
| Average consumption per hour under steam ..... | Cwt. qrs. lbs. 6 2 12 | | Cwt. qrs. lbs. 7 0 0 | | The Nerbudda coal is very dirty, making it necessary to clean the fires very often, as is proved below, the soft nature of the clinker rendering the ripper almost useless. |
| With the above expenditure, the throttle-valve and steam-gauge, taken hour by hour, stood as follows..... | Throttle-valve. | Steam-gauge. | Throttle-valve. | Steam-gauge. | |
| | Open. | 5 lbs. | Open. | 5 lbs. | |
| | Do. | Do. | Do. | 3½ to 4½ lbs. | |
| | Do. | Do. | Do. | Do. | |
| | Do. | Do. | Do. | 3 to 4½ lbs. | |
| | Do. | Do. | Do. | Do. | |
| | Do. | Do. | ¼ open. | 1¾ to 4 lbs. | Obliged to clean all the fires. |
| | Do. | Do. | ½ do. | Do. | |
| | Do. | Do. | ¼ do. | Do. | |
| | Do. | Do. | ¼ do. | Do. | |
| | Do. | Do. | ⅛ do. | Do. | Obliged to stop the engines, as the steam was below the atmospheric pressure, to clean all the four fires, as the Nerbudda coal had formed a cake over the bars, that effectually prevented the fires from burning. |
| Ashes formed from coals during ten hours' steaming .. | 1 bucket. | | 58 buckets. | | |

(Signed) H. W. Grounds, Lieut. Commg.

„ Hector M. Grant, Engineer.

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From R. N. C. Hamilton, Esq., Resident at Indore,

To Lieut. Col. P. M. Melvill, Secy. to Govt., Marine Dept., Bombay.

*Dated Indore Residency, 23rd April* 1849.

Sir,

I shall be obliged by your submitting a request on my part to the Right Honorable the Governor in Council, that should any of the Nerbudda coal

remain, one or more experiments be directed to be made in the Steam Factory, with a view to ascertain its qualities. I am induced to urge this, as the last experiment reported (the particulars of which I have not seen) is so entirely opposed to the many previous ones.

It is a well established fact that the same description of coal will not suit every description of boilers, and therefore a further experiment seems desirable.

I have, &c.

(Signed) R. N. C. HAMILTON,
Resident.

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From the SECRETARY TO GOVERNMENT, Marine Department, Bombay,

To the COMMANDER IN CHIEF OF THE INDIAN NAVY.

*Dated the 25th May* 1849.

SIR,

I am directed to transmit the accompanying copy of a letter from the Resident at Indore, No. 468, dated 23rd ultimo, and to request, that should any of the Nerbudda coal remain in store, it may be submitted to such tests, in the Factory or elsewhere, as may place its quality as far as possible beyond the reach of doubt, or question.

I have, &c.

(Signed) J. G. LUMSDEN,
Secretary to Government.

*Bombay Castle, 25th May* 1849.

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MARINE DEPARTMENT.

From Commodore STEPHEN LUSHINGTON, Commander in Chief, I. N.,

To the Right Honorable LORD VISCOUNT FALKLAND,
President and Governor in Council.

*Dated Bombay, 18th August* 1849.

MY LORD,

With reference to Mr. Secretary Lumsden's letter No. 596, of the 25th May last, I have the honour to submit the enclosed Report of a Committee appointed to test the coal received from the Valley of the Nerbudda.

2. From this Report it will be seen that the coal in question, when tested in the state in which it was received, was, as formerly represented, very inferior; but when separated by sifting from the foreign matter with which it had been unavoidably mixed up in the various stages of its transit to Bombay, it has been found nearly if not quite equal to the best description of Government coal.

3. From the result of this trial it may be inferred, that when better means are prepared for the transmission of the coal, it will render us independent in a great measure of the foreign supply, and, consequently, be a great acquisition to the resources of the country.

I have, &c.

(Signed) STEPHEN LUSHINGTON, Commodore,
Commander in Chief, Indian Navy.

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To Commodore S. LUSHINGTON, Commander in Chief, Indian Navy.

SIR,

In obedience to your orders dated 13th June, directing us to assemble in Committee, for the purpose of testing a quantity of Nerbudda coal forwarded by Government for that purpose, we have now the honour to report, in a tabular form, the result of several experiments made at different times with the boiler of the Factory engine. The result is that the Nerbudda coal, when sifted, is in all respects quite equal to the best coal usually imported here for the use of the Government steamers. Whether the large quantity of sand and dirt which we found it to contain has been introduced on its transmission to the Presidency, we have no means of ascertaining.

| Time of getting up Steam, and Quantity of Coal and Wood consumed. | Coal consumed per Horse-power during 7 hours' Steaming; Steam kept up at 4 lbs. Pressure. | Ashes and Clinker per lb. of Coal consumed during 7 hours' Steaming. |
|---|---|---|
| | *Nerbudda Coal as received.* | |
| 62 min.; 330 lbs. of coal; 56 lbs. of wood. | 9.20 lbs. per horse-power. | 0.434 lbs. |
| | *Nerbudda Coal when sifted.* | |
| 70 min.; 336 lbs. of coal; 56 lbs. of wood. | 7.60 lbs. per horse-power. | 0.210 lbs. |
| | *Best Government Coal.* | |
| 85 min.; 301 lbs. of coal; 56 lbs. of chips. | 7.85 lbs. per horse-power. | 0.204 lbs. |

(Signed) R. ETHERSEY,
Assist. Supt., and President.

„ A. CURSETJEE,
Chief Eng. and Insp. of Mach.

„ D. MACLAREN,
1st Assist. to Chief Engineer.

*Bombay*, 13*th August* 1849.

From Lieut. Col. P. M. MELVILL, Secy. to Govt., Marine Dept., Bombay,

To the RESIDENT AT INDORE.

*Dated the 6th September* 1849.

SIR,

With reference to the letter from this department, No. 597, dated 25th May last, I am directed to transmit for your information the accompanying copies of a letter from the Commander in Chief of the Indian Navy, dated the 18th ultimo, and its enclosure, reporting the result of a further trial which has been made of the coal obtained from the Valley of the Nerbudda.

I have, &c.

(Signed) P. M. MELVILL, Lieut. Colonel,

*Bombay Castle, 6th September* 1849. Secretary to Government.

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From R. N. C. HAMILTON, Esq., Resident at Indore,

To J. G. LUMSDEN, Esq., Secy. to Govt., Bombay.

*Dated Indore Residency, 17th October* 1849.

SIR,

I have had the honour to receive your despatch dated 6th ultimo, forwarding copy of the Report on the recent trial of the Nerbudda coal; and with reference thereto, beg to forward, for submission to the Right Honorable the Governor in Council, copy of my address to the Government of India, and of the reply thereto, conveying sanction to the disbursement of Rs. 500 in sinking a shaft in the coal-field at Sonadeh.

I have, &c.

(Signed) R. N. C. HAMILTON,

*Indore Residency, 17th October* 1849. Resident.

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From R. N. C. HAMILTON, Esq., Resident at Indore,

To Sir H. M. ELLIOT, K.C.B., Secy. to the Govt. of India,

With the Governor General.

*Dated Indore Residency, 12th September* 1849.

SIR,

Having received from the Government of Bombay a copy of your despatch No. 399, dated 13th May 1848, I became informed that the Most Noble the Governor General did not consider it desirable to prosecute further the experiments on the Nerbudda coal raised by me at Sonadeh, and forwarded to Bombay under the charge of Captain Fenwick (Nizam's establishment), by

the Nerbudda; that, in fact, the experiments had established the unfitness of the coal.

2. Feeling satisfied that there must have been some mistake, I addressed the Bombay Government on the subject, requesting a further experiment might be made, those which had formerly been reported having given such very different results.

3. I have now the honour to forward a copy of my letter,* and of the reply thereto from the Governor in Council, with a copy of the despatch from the Commander in Chief of the Indian Navy, submitting the Report of a Committee assembled to test the coal which remained in store.

4. This Report fully supports those formerly made; and in the words of His Excellency the Commander in Chief, "when better means are prepared for the transmission of the coal, it will render Bombay independent in a great measure of the foreign supply, and, consequently, be a great acquisition to the resources of the country."

5. Whether, under these circumstances, it may be worth while to incur an expense of Rs. 500 in sinking a shaft, as originally proposed by me, next February, is for the Governor General to decide. Should His Lordship be pleased to sanction this outlay, I will with pleasure make the necessary arrangements.

I have, &c.

(Signed) R. N. C. HAMILTON,
Resident.

*Indore Residency, 12th September* 1849.

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From P. MELVILL, Esq., Under Secy. to the Govt. of India,
With the Governor General,

To R. N. C. HAMILTON, Esq., Resident at Indore.

*Dated Simla, 6th October* 1849.

SIR,

In reply to your letter dated the 12th ultimo, No. 77, respecting the Nerbudda coal, and with reference to the 5th paragraph, I am directed to communicate the sanction of the Governor General to the expenditure of Rs. 500 for sinking the shaft proposed by you as an experiment.

I have, &c.

(Signed) P. MELVILL,
Under Secy. to Govt. of India, with G. G.

*Simla, the 6th October* 1849.

(True copy)
(Signed) ALFRED HARRIS,
Offg. 1st Assist. to Resident.

* Resident, dated 23rd April 1849, at page 108; reply, dated 6th September 1849, at page 111.

From R. N. C. HAMILTON, Esq., Resident at Indore,

To Lieut. Col. P. M. MELVILL, Secy. to Govt., Marine Dept., Bombay.

*Dated Camp Sindwah, 20th January* 1851.

SIR,

The Government of India, when the experimental dispatch of coal from the Valley of the Nerbudda, sanctioned by the Honorable the Governor in Council, was in progress, authorised an expenditure of Rs. 500 in sinking a shaft, with a view to ascertain the extent and direction of the coal-bed from which the sample forwarded to Bombay in charge of Captain Fenwick (Pension Establishment) had been raised, under my orders, by Mr. A. Johnstone, recently appointed to the Coal Department in Bombay.

2. I have not yet, however, expended the amount sanctioned ; but as the season for sinking the shaft has arrived, I would wish again to bring the very important subject of coal being supplied for our own territories under the consideration of the Right Honorable the Governor in Council, because I have heard that a great scarcity of coal, owing to the loss or detention of the colliers from England, is now felt in Bombay ; and, indeed, owing to a deficiency of coal, the steamer *Queen*, on her recent voyage from Aden, was compelled to break up part of her lower deck, a portion of the paddle-boxes, and one of the large boats.

3. Such occurrences, and the possibility of their recurrence, induce me to press on the Government the advantage of having a large quantity of the Nerbudda coal raised and transported to Broach, there to be available to meet any emergency.

4. Mr. A. Johnstone is now in the Government Service, and attached to this department : from no one can better information be obtained, and to no one could the duty be entrusted with better prospect of success. Captain Fenwick, too, is likely to be available, should his services be required ; or he might be employed on a salary of Rs. 4 per diem to raise coal during the dry season, and arrange for its transport during the rains, if only the Government will incur a certain outlay, or the expense which may be absolutely necessary to raise a given quantity of coal, in addition to the pay of Rs. 4 per diem for superintendence.

5. I shall be most happy to render every aid in my power ; and, if Captain Fenwick's services should be desired, to secure them, he having recently completed an inquiry into the teak forests, on which he was employed by the Madras Government.

I have, &c.

(Signed) R. N. C. HAMILTON,
Resident.

*Indore Residency, Camp Sindwah, 20th January* 1851.

From Lieut. Col. P. M. MELVILL, Secy. to Govt., Bombay,

To the SECRETARY TO THE GOVERNMENT OF INDIA.

*Dated the 28th February* 1851.

SIR,

With reference to your despatch No. 133, dated 17th February 1849, prohibiting this Government from incurring any further expense upon the coal mines of Sonadeh, I am directed by the Right Honorable the Governor in Council to transmit, for the consideration of the Government of India, the accompanying copy of a letter from the Resident at Indore, No. 79, dated 20th ultimo, urging the expediency of having the mines in question worked, and a coal depôt formed at Broach, to meet any emergency which may arise.

2. The Governor in Council directs me to observe, that no argument can be needed to prove the importance of having a depôt of coal at Broach available when required; but it has not yet been rendered certain that coal of a quality such as can be used by sea-going steamers can be obtained from the mines in the Nerbudda Valley.

3. A combination of unfortunate accidents lately caused a great and alarming deficiency of coal in the Aden depôt; but this, I am to state, could neither have been prevented nor rectified by any store at Broach: there was coal sufficient in Bombay; but the difficulty felt was the expense and loss of time in transporting any quantity to Aden.

4. The Resident, I am further to observe, is misinformed in attributing the long voyage of the Steamer *Queen* to any want of fuel. The Commander in Chief of the Indian Navy, as will be seen from the accompanying extract paragraph 2 of his letter dated 12th instant, has reported that she had on board her full stowage of coal, and no complaint was made of its quality. The detention in the passage arose from other causes.

I have, &c.

(Signed) P. M. MELVILL, Lieut. Colonel,

*Bombay Castle, 28th February* 1851. Secretary to Government.

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From F. J. HALLIDAY, Esq., Secy. to the Govt. of India,

To Lieut. Colonel P. M. MELVILL, Secy. to Govt., Bombay.

HOME DEPARTMENT, MARINE.

*Dated the 11th April* 1851.

SIR,

I am directed to acknowledge the receipt of your letter dated the 28th February last, transmitting a communication from the Resident at Indore, re-urging the expediency of having the coal mines of Sonadeh worked, and suggesting the establishment of a coal depôt at Broach.

2. By my letter of the 17th February 1849, the Right Honorable the Governor in Council was informed that it was the intention of the Supreme Government to depute Surgeon McClelland to the Nerbudda Valley, with the view of examining and reporting on the coal-fields at Sonadeh. Hitherto, however, it has not been found practicable to give effect to this intention, owing to the employment of Dr. McClelland on other duties. But as the recent arrival from England of Professor Oldham, appointed by the Honorable the Court of Directors to conduct a Geological Survey of India, may place the Supreme Government in a position to carry out, hereafter, the intention above referred to, I am directed to acquaint you, that as soon as Mr. Oldham shall have completed his examination of certain localities under the Bengal Government, the President in Council will take into consideration the propriety of deputing him to the Valley of the Nerbudda. Until then, the President in Council hopes there can be no objection to the survey of the coal-fields at Sonadeh being deferred.

I have, &c.

(Signed) F. J. HALLIDAY,
Secy. to the Govt. of India.

*Fort William, the 11th April* 1851.

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*Extract Paragraph* 11 *of a Despatch from the Honorable Court to the Government of India, dated the* 18*th June* 1851, *No.* 4.

Report of a further trial of the coal from the Nerbudda Valley.

11. It is very satisfactory to find that renewed experiments on this coal have been attended with more encouraging results than were at first obtained. It would seem that the apparent inferiority of former specimens of the coal was owing to the intermixture of a quantity of foreign matter; but that when freed from such matter, the coal has been found nearly equal in quality to the best English coal.

# EXTRACTS FROM A REPORT

RELATING TO THE

# NERBUDDA RIVER AND VALLEY,

BY


## MR. J. J. BERKLEY,

CHIEF RESIDENT ENGINEER, BOMBAY, OF THE GREAT INDIAN PENINSULA RAILWAY COMPANY;


ADDRESSED TO THE

## COMMITTEE OF DIRECTORS OF THAT COMPANY,

*Under date the 6th October* 1854.

# EXTRACTS FROM A REPORT

RELATING TO

# THE NERBUDDA RIVER AND VALLEY.

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It might appear that it would have been advisable to carry the main line of the Great Indian Peninsula Railway through Berar by Nagpore, instead of by Asseer, Hurda, and Hooshungabad, into the Nerbudda Valley, and so on to Mirzapoor; but an examination which Mr. Graham has made, of the country between Nagpore and the Nerbudda, has proved that course to be most unfavourable for a line of railway. Moreover, the route which we have taken passes through a populous and well cultivated district, while the other, between Nagpore and the Nerbudda, would cross an almost unbroken jungle. At the close of next season I shall be able to report to you more fully upon this subject.

The line comprised in Section No. 3 commences from the Asseerghur and Boorhanpoor road, at one hundred and fifty-three and a half miles, and traversing a plain (smooth for three miles, but beyond that intersected by numerous deep narrow ravines), reaches the foot of the Satpooras, which it ascends by a series of easy reverse curves. Between the hundred and fifty-eighth and hundred and sixty-second mile, it crosses four large nullas, which, rising among the hills, flow out as mountain torrents, and, scouring to a great depth into the light soil of the plain, and fed by the minor streams, soon become formidable rivers. Where we cross them, however, the works are inconsiderable, although they are the most extensive upon these nine miles of the section. After crossing the river Pandar by a bridge about fifty-five yards long, the line takes a direction a little to the west of north, and, about the hundred and sixty-seventh mile, crosses the road from Asseerghur to Sewul, at a distance of six miles from the former place; and then, climbing the hill for about three miles, bears north-east, and passing Umdanuggur, reaches the summit of the Satpoora range at one hundred and seventy-five miles and three quarters. The height of this summit is inconsiderable, being only three hundred and ninety feet above the level of the Taptee Valley; and its ascent is effected in a distance of twelve miles, without any works that call for observation, and with various gradients, the worst of which is 1 in 100 for a length of about a mile and three quarters. From the

summit the line descends by a gradient of 1 in 118, to the hundred and seventy-seventh mile, where Section No. 3 terminates.

Between Asseerghur and the summit, the line passes over the trap formation; but the rock appears upon the surface only in a few places, and the earthwork will not be of an expensive character: stone suitable for building, teak, and ballast, are procurable in abundance for the works along these twenty-three and a half miles. There are very few level crossings; and only one small station, at the Asseerghur and Sewul road, will be required.

Tables of the curves and gradients are appended. They are both of a good working character, one-half of the section being either level or of first class gradients, and straight; and when it is considered that the Satpooras, one of the most formidable ranges upon this side of India, are surmounted by them, they are far more favourable than I expected it would be possible for us to obtain.

Some improvements may probably be made hereafter in this portion of the line; but they will not be of such importance as to affect my estimates, or to alter materially the general character of the section.

The next section of the line, No. 4, extends from the hundred and seventy-seventh mile, near the Asseer summit of the Satpooras, to Charwar, in the Valley of the Nerbudda, two hundred and thirty and a half miles; but no plan of it has been made, for the reasons which I have already assigned. Its course is by Ruttyghur, far to the east of Mandwa, and in a direction parallel to the river Suktha, and at a considerable distance from its right bank. It crosses the road from Peepleod at the hundred and eighty-second mile, the road from Bhamghur to Goondwana in the hundred and ninety-second, and the rivers Gungapot and Ogguny at the two hundred and second and two hundred and fourth miles, with small viaducts. From the Ogguny, it rises by a gradient of 1 in 132 for three miles and a quarter, and then descends by the same gradient for two miles, to most favourable ground, along which it runs to Charwar for a distance of twenty miles, without encountering any works that call for notice.

From Boorhanpoor to Charwar the line passes through a thickly wooded country. It is the direct route, but lies to the east of the present course of the traffic from Hurda, which there follows a circuitous road by Jawar, Kurdwa, Boregaon, Asseer, and Boorhanpoor, because along that route there are more halting-places; but Captain Keatinge, the Political Agent in Nimar, has already had a survey made of a road by Peepleod and Jawul, so that the course followed by the line will there meet the requirements of the traffic. The soil along this section is composed of that indurated trap mixture of sand, perished stone, and clay, which is here known by the name of Moorum, and is very favourable for our excavations. The works upon it are of a light description, and the gradients, of which a table is appended, are good; and the direction of the line is very favourable. Some improvements may, perhaps, be effected in it when the line is laid out for construction, and, in particular, I

may mention that the summit which I have described at the two hundred and sixth mile may, I believe, be altogether avoided.

Observing from the returns of Sir Robert Hamilton, Bart., Resident of Indore, and Captain Keatinge, that there is a decided set of the trade and passenger traffic from Hurda and the Nerbudda Valley towards Indore, and with a view of approaching the rich iron mines of Chandgur and Ponassa, a trial branch line has been laid out, and the section of it taken from Hurda to Poornee, as shown in the accompanying general map of the Nerbudda Valley. Should it be decided to extend your railway through Nimar to Indore and Agra or Delhi, it would be a question whether the line from Asseer summit might not be carried further to the west along the course of the river Suktha, as in that case the Bombay and Calcutta and the Bombay and Agra lines would diverge near Poornee, and the trial section which has been taken would form a portion of the line to Mirzapoor.

The stations upon this section will be at Charwar and Hurda.

Section No. 5 commences near Charwar, at a distance of two hundred and thirty-one miles from Munmar, and three hundred and ninety-one miles from Bombay, and extends up the Nerbudda Valley to the Towah, one of its tributaries, at the three hundred and third mile. No survey has been made of this line as far as Charkeira; but it has been accurately laid out upon the ground, and a reference to the section will show that it presents favourable features in every respect.

From Charkeira, the line runs to the north of Timboornee, and at the two hundred and sixty-sixth mile crosses the river Gunjal, which is one hundred and ninety yards wide, and its floods rise to a height of forty feet. From this point it continues of an equally favourable character for twelve miles, where it passes the very busy and prosperous town of Sewnee. It thence keeps along the flat and easy ground of the Nerbudda, and, passing about eight miles to the east of Hooshungabad, reaches the river Towah at the three hundred and third mile, which is the termination of this section.

Nothing could be more favourable in every respect than the whole of this section, seventy-two miles in length. The only work upon it is the crossing of the Gunjal, which is of moderate extent, and very much resembles the river crossings upon our experimental line between Callian and Wasindre. Nearly the whole of it is straight, and the gradients are unexceptionable. The country it traverses is productive, populous, and active. Nothing, in fact, could exceed the advantages of the district from Hurda to the Towah. It is a fine level plain, presenting every facility for the construction of a railway, and covered in all directions with rich abundant crops, fine trees, and prosperous villages; and a reference to the plan will show how many communications already exist upon it. These roads have been carried under the railway in many instances, and the level crossings thus reduced to a moderate number. The stations upon this section will probably be as follows:—

At Timboornee, Sewnee, Dakaira, for Hooshungabad, Charkeira, and Kotra.

Section No. 6 commences on the left bank of the river Towah, at the three hundred and fourth mile from Munmar, and extends to Katiotia, at the three hundred and ninety-second mile. The Towah is very nearly dry during the fair season, but in the rains its shallow though very wide course is flooded for a width of twelve hundred and seventy-six yards from bank to bank. The floods, however, have seldom been known to rise above its lower or eastern bank, and I therefore believe that its channel might very safely be contracted to a considerable extent. The bed of this flood stream is a mass of loose sand for a depth of about twelve feet, when it becomes firm, and suitable for either piling or masonry foundations; but in the present instance I have estimated this viaduct of simple timber piling, and gearing wide enough for a single line of rails, and extending along the whole channel of the river. The course of this river has been carefully examined from Hooshungabad to Kaika, near the hills, where it issues at even a greater width than at our crossing; and no place has been found more favourable than the spot best suited for the direction of the railway. Under any circumstances, therefore, it must prove an expensive work; but beyond that, there is no feature in it which is at all calculated to affect the eligibility of the line.

From the Towah, the line extends for nine miles over a level plain, and, entering upon some undulating easy country near the three hundred and fourteenth mile, proceeds in almost a straight line, and without a single objectionable feature, to the three hundred and fifty-eighth mile, where it crosses the river Doodhye, at the village of Joonhetti, with a viaduct of ordinary dimensions. From the crossing of this river the line runs quite free from works along the surface of the country for fourteen miles, where it approaches the town of Garrilwara. It there has to cross the river Sukur, by a viaduct one hundred and seventy yards long. From the river Sukur it becomes a practically straight surface line, over a level country, as far as the three hundred and ninety-second mile, where it crosses the road to Katiotia, the termination of Section No. 6. By the tables of curves and gradients it appears that seventy-three miles out of eighty-seven are either level, or of first class gradients, and that sixty-five miles are straight.

The material for earthwork upon this section will be the alluvial soil of the valley; stone and lime for building purposes are procurable, generally, from the hills at a short distance to the south of the line; teak of large scantling, and other good woods, abound in the Shahpoor jungles, about thirty miles from the railway, along the Towah; and timber and other materials can be conveyed down the Nerbudda early in the season. This portion of the line passes about nine miles from Mowpani, at the outcrop of the Benar coal, of which there appears to be abundance in that district. It may, perhaps, be practicable to pass somewhat nearer to it; but from our last season's operations it did not seem advisable to lengthen the line for that purpose, because we should then have to encounter the Seta Rewa, which has scoured out a deep and broad channel in the plain, and its course as far as its junction with

the Sukur, near Garrilwara, which will have to be followed by the railway, is very tortuous. We have as yet made no survey for the purpose of ascertaining the extent and quality of the seams of coal; I recommend, however, that this should be done before the engineers leave that part of the country. Near Mowpani two seams of coal have been superficially opened out last season; but no shaft has been sunk, nor has any attempt been made to work the coal up to this time, although it has been frequently picked up in various places, and favourably reported upon. The stations upon it will probably be at Sohagpoor, Garrilwara, Babye, Seemry, Hutwas, Bunkerry, Kaislah, and Sehora.

Section No. 7 commences near Katiotia, at the three hundred and ninety-second mile, and crosses the river Baroorewa, about sixty yards wide, in the three hundred and ninety-fourth mile, with much broken ground on either side. At the three hundred and ninety-fifth mile it crosses on a level the Hooshungabad and Jubbulpore main road, and then passes close to Nursingpoor, the well known and important mart for the cotton and grain of this part of the country. After passing a small stream called the Singery, and recrossing the Hooshungabad and Jubbulpore road in the three hundred and ninety-seventh mile, the line continues of the most favourable character until it approaches within a mile of the Shair, where the ground is cut up by deep ravines. That river is crossed at the four hundred and fourth mile, where its width is one hundred and ninety yards: its banks are precipitous, and the extreme height of the flood has been known to reach sixty feet above the bed, although its ordinary level is about forty feet. From this point the railway runs generally upon the surface of a very even tract of country, as far as the four hundred and twenty-fourth mile, and presents nothing worthy of remark, except the crossings of two or three streams, with sandy beds, and soft crumbling banks. It then approaches the Nerbudda, and traverses some broken ground, much intersected by nullas. At the crossing of the Nerbudda, its banks are very high and precipitous, especially on the north side. The total width from bank to bank is four hundred and fourteen lineal yards. The flood of last year, the highest on record, rose ninety feet above the river bed, but subsided in an hour or two. The ordinary floods rise seventy-four feet. During the dry season, however, building operations may be carried on with facility, as the river contains very little water; and early in May, when our section was taken, the extent of dead water in it was only seventy-one yards wide, and its greatest depth only five feet.

The course of the Nerbudda was examined for thirty miles from Sukur, at the junction of the Huran, on the western side of the railway, to Beira Ghat on the east. Near the Beira Ghat the channel is much contracted, and runs through perpendicular rocks of white marble. The facilities which this circumstance would appear to offer could not be taken practical advantage of, because during the floods the Nerbudda not only rises high above those rocks, but before entering the gorge finds for itself another wide channel through soft soil; and

added to this, a more serious objection was found to exist in the almost insurmountable difficulties of the country between Chindwara and the Beira Ghat.

The crossing of the Nerbudda which we have selected is near Jhansee Ghat, to the west of the ford of the Jubbulpore road. The viaduct will be three hundred and seventy-one yards long, and I estimate the cost of it for a double line of rails at £40,000. The bed of the river is rock, and I see no reason to expect that any important engineering difficulties or expensive contingencies will be met with in the execution of this large work. It is advisable, while the dimensions and probable cost of our crossing of the Nerbudda are under consideration, to draw your attention to that other crossing of it which has been contemplated near Broach. The spot which we have selected for bridging it is upwards of five hundred miles above the town of Broach; and along nearly the whole of that great distance the Nerbudda receives the immense drainage of the Vindhya and Satpoora ranges of mountains, for which a continuous water-way several miles in length must be provided. Moreover, at the proposed crossing, not only will the floods require an extent of bridging for which railway engineering practice affords no precedent, but the execution of the work within the channel of the river will be encumbered with difficulties and expense by the large body of water, twenty-eight feet deep, which it contains even at the lowest tides; by the ordinary tide, which rises ten feet, and is of unusual velocity near Broach; and by the enormous inundations, which rise about seventy feet above the bed of the river, and spread for miles over the country in one vast sheet of water, sometimes as much as ten feet deep. Whether the proposed crossing of the Nerbudda at Broach be judged of by analogy with ours near Jubbulpore, or whether the drainage of two ranges of mountains for nearly five hundred miles be taken as the measure of the work, its proportions must be extreme. The character of this most formidable projected work bears indirectly upon your interests, and cannot fail to affect in a most important degree the railway question now under the consideration of Government: I therefore request that I may be commissioned to report to you without delay upon the subject of the proposed railway crossings of the river Taptee at Surat, and of the Nerbudda at Broach, and to take the necessary steps for doing so in full detail.

After crossing the Nerbudda at the four hundred and twenty-sixth mile, the line traverses some rough ground and several nullas, for about a mile and a half, and then runs for twenty miles upon the surface of a level and even country; and at four hundred and forty-seven and a half miles reaches the Jubbulpore and Saugor road, at a distance of a mile and a half from Jubbulpore, where that part of the line upon which I now have the honour to report to you terminates.

The whole of the last fifty-five miles are of a favourable character in every respect; and if it were not for the crossings of the rivers Nerbudda and Shair, the cost of it would reach the very lowest limit. The soil is alluvial; the requisite materials are abundant; and the level crossings are few. The tables

of curves and gradients show forty-seven miles of practically level gradient, and forty-six miles of straight. The stations through this district will probably be at Nursingpoor, Jubbulpore, Peindry, Chindwara, and Kisrode.

Our field operations last season extended to Gosulpoor, a distance of eighteen miles from Jubbulpore; but I shall make no further allusion to that part of the line in this Report, because it is liable to alteration when the ascent of the Vindhyas is laid out.

Reviewing the whole of the north-eastern extension, from the top of the Thul Ghat to Jubbulpore, a distance of five hundred and twenty-two miles, the character of our line is unexceptionable, and its construction ought to be very cheap: the materials are good and abundant; the price of labour is low; and there are no engineering difficulties to be encountered upon it. * * *

The Indhyadree and Satpoora ranges, supposed to present such formidable obstacles to laying out a railway, are proved by our sections to be capable of being surmounted by a good working line, free from heavy works of any kind. Nearly its entire course traverses some of the most fertile and productive districts upon this side of India; for after clearing the Ghats it runs through the plain of the Godavery for fifty miles; crossing the Indhyadree range, it enters Khandesh, and passes through that province for one hundred and fifty miles, accommodating some of its most healthy and productive Talookas, and its principal cotton marts; then, passing the Satpooras, it ascends for two hundred and fifty miles the magnificent Valley of the Nerbudda, with its valuable coal and iron-fields, and its copious supply of grain, seeds, and cotton; and while it presents these commercial advantages, and affords this vast extent of local accommodation, it pursues a direct course for effecting the transpeninsular communication with Calcutta, and for connecting the province of Berar with the port of Bombay.

Sufficient returns of traffic have already been made to prove that a profitable revenue will accrue to your railway between Bombay and Eastern Khandesh; and beyond that it could hardly be expected that the amount of existing trade would be found sufficient to establish actual data for an equally profitable return; but there is throughout the Valley of the Nerbudda so great an abundance of marketable and exportable produce, which only awaits the opening of a quick and cheap communication to meet the demands both in this country and for export, that I believe no doubt can be entertained of the commercial success of that part of your undertaking, particularly when we regard the importance and extent of the commerce that must pass between Bombay and Calcutta, and to the great facilities of the country for the construction of a railway.

In many parts of the Nerbudda Valley coal exists, of undoubted quality, in great abundance, and lying in a most favourable position for being worked. Iron ore, too, abounds, especially on the north of the Nerbudda. The principal mines of the district are Tendukheira, about ten miles from our line, near Nursingpoor. They are now worked in the rudest fashion, but the iron produced is of excellent quality. There are furnaces also at Paneghur and Gosul-

poor, close to which our line passes; and although the iron is held inferior to that of Tendukheira, it is, I believe, good, and forms an article of export from those towns. Valuable iron mines also exist at Ponassa and Chandgur; and I find, from papers kindly furnished by Captain Erskine, Commissioner of the Saugor and Nerbudda Territories, that besides those which I have specified as the principal ones, and as lying near the course of our line, there are five mines within twenty miles of Jubbulpore.

I am not yet sufficiently informed to furnish you with a full statement of the present general traffic of the Nerbudda Valley; but I beg to append two returns from Captain Keatinge, Political Assistant in Nimar, one of which was kindly furnished to us by himself, and the other by Sir Robert Hamilton, through the Bombay Government. By these it appears that the quantity of goods sold in four bazars, and which passed four points in Nimar in the year 1853, amounted to 12,417 tons, of which the trade to Bombay is entirely the growth of five years, and is increasing rapidly.

The traffic on the Agra and Bombay road, taken at Akbarpoor for twelve months from April 1853, was as follows :—

| | |
|---|---|
| Foot passengers | 95,750 |
| Bullocks and horses | 21,229 |
| Carts | 18,087 |
| Camels | 2,445 |
| Elephants | 46 |
| Buffaloes | 938 |
| Asses | 293 |
| Palanquins | 121 |
| Sheep and goats | 964 |
| Carriages | 26 |

The return of traffic on the Boorhanpoor and Indore road, taken at Kherry Ghat for twelve months, from April 1853 to May 1854, gives—

| | |
|---|---|
| Foot passengers | 26,141 |
| Palanquins | 17 |
| Sheep and goats | 102 |

As well as the goods comprised in Captain Keatinge's statement of the Nimar traffic.

In addition to these, we are indebted to Mr. Williams, Overseer of the Schools of Industry at Jubbulpore, for the following statement of the annual trade to and from that station; and from his long residence there, and his knowledge of the commerce of the country, it may, I am sure, be safely relied upon :—

| | |
|---|---|
| Cotton | 8,571 tons. |
| Wheat | 4,285 „ |
| Hemp, gum, ghee, iron, and other commodities | 1,585 „ |
| Hides | 100,000 Nos. |
| Imports about | 11,553 tons. |

Making a total of upwards of 26,000 tons for the present trade for Jubbulpore.

In transcribing the results of these returns, I by no means intend to imply that this traffic properly belongs to our line between Bombay and Jubbulpore; but my purpose is to show, by reference to its present trade, that the district of the Nerbudda is likely to afford us a very large traffic. No statistical returns could present a correct estimate of the traffic that would be created, if the Nerbudda Valley possessed a railway communication with the ports of Calcutta and Bombay. It is now practically shut up; but the exports of coal, iron, cotton, wheat, hemp, linseed, timber, and other products, and the imports of salt and manufactured goods, must eventually become immense.

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The estimates* have been framed upon my experience in the construction of our works, and upon accurate data, obtained by Mr. Graham, respecting the local prices and facilities of those districts through which this extension would pass. The prices of iron have been fixed at the high rates which we paid for our last supplies; and as the market has since risen, it may possibly happen that my estimates of the permanent way may fall short in that particular. My rates, however, are above the average, and the future turn of the market may therefore be in our favour. In any event, I beg to protect my estimates from this speculative contingency.

The cost of a single line of permanent way upon the several sections of this extension varies from £2,810 to £3,160 per mile, which is more than one-half of the total mileage cost of each section. As this large proportion arises chiefly from the high prices of the English iron materials, and from the great expense of conveying them from the port to the interior of the country, the expediency and advantage of establishing the means of providing a local supply of rails, chairs, spikes, &c. are clearly pointed out. Although great encouragement for the early establishment of ironworks exists in the valuable character of the mines, in the great and urgent demand for iron in this country, and in the fact that the high prices of English permanent way materials will be a serious and undue impediment to the cheap construction of railways through the interior of India, yet it is very doubtful whether the Nerbudda coal and iron-fields can be worked so expeditiously and economically as to afford us much benefit in the construction of the railway between Bombay and Khandesh. In fact, I am inclined to think that active and successful operations in that enterprise will be found to depend more upon the completion of a railway communication between Bombay and the Nerbudda Valley than the railway does upon a local supply of coal and iron.

* Of £6,380 and £6,178, as an average cost per mile. The estimates are omitted for brevity.—*Editor.*

# EXTRACTS FROM A REPORT

(DATED THE 28TH APRIL 1854)

RELATING TO THE

# MINERAL DISTRICTS, &c. OF THE NERBUDDA VALLEY;

ADDRESSED BY

LIEUTENANT COLONEL J. P. KENNEDY,

MANAGING DIRECTOR AND ENGINEER IN CHIEF, OF THE BOMBAY, BARODA, AND CENTRAL INDIA RAILWAY COMPANY,

TO THE DIRECTORS OF THAT COMPANY:

WITH ACCOMPANYING REPORTS ON THE SAME SUBJECT,

BY MR. JACOB AND MR. GREEN.

# EXTRACTS FROM REPORT

BY

# LIEUTENANT COLONEL J. P. KENNEDY.

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The first question to be answered by a railway company in India is, how they are to bridge their rivers and nullas. This, accordingly, has been our chief subject of consideration. In reference to it, I have framed a comparative estimate* of the ordinary modes of executing a viaduct by the use of masonry or of iron; considering likewise whether the iron to be employed shall be of English or of Native Indian manufacture, provided the latter can be obtained. The present competition price of English iron having reached about double the first cost remunerative price under the former steady rates of wages, and the probable future demand upon the English market from foreign, colonial, and Indian railways in particular, make it probable that even the present high competition prices may still be largely increased, unless additional supplies can be produced elsewhere. Nor would a moderate increase of produce go far in keeping down the competition price contemporaneously with a very large increasing demand for that produce. No railway company, under such circumstances, could expect to obtain their iron at anything near to a fair remunerative price, unless by manufacturing it on their own account. A foundry opened in India by an ordinary speculator would have little effect, except as regards the question of freight, in reducing the price of iron to any particular railway company, beyond what an additional foundry of the same manufacturing power established in England would have; the price of its produce being regulated, as a matter of course, by the general rate of the market.

It was in this view of our case that I selected a Geologist to accompany our first Surveyors, and his attention has been devoted exclusively to the mineral districts of the Nerbudda in the vicinity of our line.

His efforts have been most successful, and his Reports† will be read with much interest. Mr. Jacob states the existence of a rich and inexhaustible

* Copy of which is given at pages 134 and 135.

† Copies of which, dated the 1st and 4th April 1854, will be found at pages 136 to 144.

supply of iron ore at Chandgur, with an ample quantity of lime and timber for charcoal in the immediate vicinity, as well as a first-rate quality of coking coal in large quantities, and easily obtained, at Benar, higher up the river. The ground between the coal and iron, and that between the proposed foundry and our general line, he states to be most favourable for railway construction, and situated in a rich traffic district.

By referring to Appendix No. III.,* we find from the comparative estimate, that if we construct our viaducts, rails, &c. of Native iron of our own manufacture, we may calculate on executing our railroad at an average rate of £3,999 per mile; that if we adopt the same principle of construction, but purchase our iron in the English or other market, we may calculate on expending £7,041 per mile; and if we use brickwork or masonry viaducts, with English iron rails, our outlay would be £8,717 per mile.

Hence, then, the very first preparation that I should earnestly recommend, to enable us to secure the most successful result in our future railway operations, would be the immediate establishment by our Company of a Native iron foundry.

I can have no hesitation in recommending that the site of such foundry shall be at, or near Ponassa, in the neighbourhood of what I believe to be the best iron district in India, the ore being as inexhaustible in its quantity as it is superior in quality. I am justified in recommending the adoption of this locality upon the authority of our Geologist, who has devoted much time to its examination, and comparison with other mineral districts, and who has tested its ores by repeated and careful analysis; and also upon the still more convincing fact that its ores have been manufactured from time immemorial, and continue to be manufactured extensively to the present day by the Natives, in their own rude, costly method, and that the metal they produce, the Chandgur iron, has always been considered of the very highest quality; that the situation of Ponassa is considered healthful; that there is the best quality of lime for our purpose in close proximity; that there is a very large supply of charcoal jungle in the neighbourhood; and that when that may fail, we have a first-rate quality of inexhaustible and easily worked coking coal, higher up the river, to depend upon for our fuel, the road to which would pass through a country favourable for railway construction, and a good traffic district.

Under these circumstances, I cannot hesitate to recommend the immediate establishment of an iron foundry at, or near Ponassa, as an indispensable essential to the fullest success of our railway operations.

The attention of one of our Engineers, Mr. Green, has been especially given to test the beds of the principal rivers. He was furnished with the requisite boring tools for this purpose, having had considerable experience in the construction of viaducts such as we require. His examination of the

* Being Report by Mr. Jacob on the Mineral Districts of the Nerbudda Valley, a copy of which will be found at pages 136 to 144.

Taptee and Nerbudda justifies me in recommending* that those rivers should be bridged by an iron superstructure, supported on iron pile piers.

* * * * * * * * * *

A line from Baroda to Indore would admit of extension eastward to connect with the Calcutta line at or near Allahabad, and it could throw off branches to the northward to any extent that the traffic of the district might require. This line commands, likewise, the power of giving an approach from the northward to the Nerbudda mineral district, by an extension branch along the Nerbudda north bank, from the point it reaches before entering the Vindhya Pass; and I believe it is impossible to overrate the beneficial consequences that the Nerbudda mineral district is calculated to produce in the industrial development of India, if properly dealt with.

* * * * * * * * * *

My reason for not having executed a section of the line from Julgaum to the proposed Ponassa foundry, and thence to the Benar coal-field is, that being quite satisfied with the Report of Mr. Jacob, together with my own observations as to the facility of constructing a good line through that district, when I went to put a party to take the section, I found the engineers of another company already occupied in the same work, and it appeared quite superfluous that a duplicate section should be taken by me, when so much important information was wanting on other districts; I therefore placed my party elsewhere. The information furnished by the other company will be no doubt ample to enable the Government to come to a decision on all matters relating to the district in this respect.

* Vide Mr. Green's Report, at pages 144 and 145.

# ESTIMATE BY LIEUTENANT COLONEL KENNEDY,

ALLUDED TO AT THE COMMENCEMENT OF THE FOREGOING EXTRACTS.

*A Comparative View of the proximate Cost of Constructing an average Mile of Single Truck Railway by each of Three Methods of making the required Viaducts and Bridges, viz.* 1st, *by using Masonry or Brickwork;* 2nd, *by using English Iron;* 3rd, *by using Native Iron. The Embankments are assumed to average* 9 *feet in height to Formation Level. Average Length of Viaducts or Bridges per Mile* 1-27*th of the entire.*

| Detail of Works. | Quantities per Mile. | Estimate per Mile, supposing Viaducts and Bridges to be of | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Masonry or Brickwork, and English Rails. | | | | English Iron. | | | | Native Iron. | | | |
| | | Rate per | | | Amount. | Rate per | | | Amount. | Rate per | | | Amount. |
| | | £ | s. | d. | £ | £ | s. | d. | £ | £ | s. | d. | £ |
| Surveying expenses | .. | .. | | | 30 | .. | | | 30 | .. | | | 30 |
| Law costs | .. | .. | | | 5 | .. | | | 5 | .. | | | 5 |
| Land | .. | .. | | | .. | .. | | | .. | .. | | | .. |
| Fencing with growing plants | .. | .. | | | 10 | .. | | | 10 | .. | | | 10 |
| | c. yds. | | | | | | | | | | | | |
| Earthworks | 58,080 | 0 | 0 | 1½ | 363 | 0 | 0 | 1½ | 363 | 0 | 0 | 1½ | 363 |
| Rock-cuttings | 10,000 | 0 | 1 | 0 | 500 | 0 | 1 | 0 | 500 | 0 | 1 | 0 | 500 |
| Bridges and viaducts | lin. yds. 64 | 60 | 0 | 0 | 3,800 | 36 | 0 | 0 | 2,304 | 9 | 0 | 0 | 576 |
| | c. yds. | | | | | | | | | | | | |
| Ballasting, 18 inches deep | 4,620 | 0 | 2 | 6 | 565 | 0 | 2 | 6 | 565 | 0 | 2 | 6 | 565 |
| | Tons. | | | | | | | | | | | | |
| Iron rails, sidings, switches, &c., 80 lbs. per yd. | 132 | 12 | 0 | 0 | 1,584 | 12 | 0 | 0 | 1,584 | 5 | 0 | 0 | 660 |
| Cast-iron sleepers | 130 | 6 | 0 | 0 | 780 | 6 | 0 | 0 | 780 | 3 | 0 | 0 | 390 |
| Laying permanent way, per lineal yard | .. | 0 | 0 | 8 | 58 | 0 | 0 | 8 | 58 | 0 | 0 | 8 | 58 |
| Station-houses, 1 to every 5 miles, at £150 each | .. | .. | | | 30 | .. | | | 30 | .. | | | 30 |
| Termini and workshops | .. | .. | | | 50 | .. | | | 50 | .. | | | 50 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Electric telegraph .. .. .. .. .. | .. | .. | 35 | .. | 35 | .. | 35 |
| Pumps, tanks, &c. .. .. .. .. .. | .. | .. | 70 | .. | 70 | .. | 70 |
| Plant for execution of works .. .. .. | .. | .. | 50 | .. | 50 | .. | 50 |
| *Rolling Stock.* | | | | | | | |
| Engines and tenders, 1 to every 10 miles, at £2,000 .. .. .. .. .. .. | .. | .. | 200 | .. | 200 | .. | 200 |
| Passenger composite carriages, 1st and 2nd class, 1 to 10 miles, at £500 .. .. .. .. | .. | .. | 50 | .. | 50 | .. | 50 |
| 3rd class carriages, 1 to every 3 miles, at £180 .. | .. | .. | 60 | .. | 60 | .. | 60 |
| Goods trucks, 1 to every 2 miles, at £60 .. | .. | .. | 30 | .. | 30 | .. | 30 |
| Horse boxes, 1 to every 10 miles, at £100 | .. | .. | 10 | .. | 10 | .. | 10 |
| Cattle trucks, 1 to every 5 miles, at £70 .. | .. | .. | 10 | .. | 10 | .. | 10 |
| Carriage trucks, 1 to every 20 miles, at £100 | .. | .. | 5 | .. | 5 | .. | 5 |
| *Superintendence.* | | | | | | | |
| Direction in England .. .. .. .. | .. | .. | 42 | .. | 42 | .. | 42 |
| Direction in India .. .. .. .. .. | .. | .. | 20 | .. | 20 | .. | 20 |
| Engineering expenses and salaries .. .. .. | .. | .. | 60 | .. | 60 | .. | 60 |
| Overseer's and gauger's departments .. .. | .. | .. | 300 | .. | 120 | .. | 120 |
| Gross Total per mile.. .. | .. | .. | 8,717 | .. | 7,041 | .. | 3,999 |

# (APPENDIX No. III.)

*Report on the Iron and Coal Districts of the Nerbudda Valley, from Ponassa to Jubbulpore.*

*Surat, April 1st,* 1854.

From Mr. A. A. JACOB, B.A.,
Asst. Engr., and Geologist to the B. B. and C. I. R. Co.,

To Lieutenant Colonel J. P. KENNEDY,
Engineer in Chief and Managing Director, Surat.

SIR,

I have the honour to lay before you a summary of the reports and observations which I have forwarded at various times, during the five months that I have been employed in the examination of the Nerbudda mineral districts.

According to my instructions, I proceeded to join Mr. Keatinge, the chief British functionary of the principal mineral districts, whom I found in camp at Asseerghur, on the 19th November last; and, acting under his advice, I proceeded to Kautkot, on the north bank of the river Nerbudda, where I arrived on the 30th November.

My attention was here directed to the iron mines belonging to Holkar, situate about four miles from the village, in the dense jungle. They were in a fearfully dangerous state, no regard being paid to the workings, the aim of the people being to extract the greatest quantity of ore without the least regard to future workings. The ore is the hydrated peroxide of iron (ochreous variety), yielding by dry assay 37.22 per cent. of iron, which may be considered as a high per-centage.

The most primitive form of Catalan forge is used by the few poor people who earn a livelihood by the manufacture of iron. A description of their furnace may not be amiss.

It is in height from three to four feet, the top section twenty inches by ten inches, and the bottom twenty-three inches by twenty-two inches. In the base of the furnace is inserted a flat earthen plate, with several indentations, which are, during the smelting, pierced for the outflow of the slag. The blast is supplied through very fusible earthen pipes by goatskins plied alternately. When these earthen pipes are burned away, the iron is finished. This process occupies about ten hours. The base of the furnace is then broken out, the lump of iron extracted, and beaten with hammers to remove the slag; the defective apparatus used obliging them to re-heat the iron five times.

I hired one of these furnaces, to find what amount of iron could be extracted. I allowed the men to work in their usual method, only taking the ore and coal

from heaps which I had carefully weighed. The following is the result of my investigation:—25 seers of iron ore consumed 26 seers of charcoal, and furnished 5.61 seers of iron (and this not in a marketable condition); thus giving 22.84 per cent. of iron; 104 per cent. of charcoal being consumed in the process, or at the rate of 4 tons 12 cwt. of charcoal per ton of iron.

A proper furnace, with this ore, could not, under the most unfavourable circumstances, consume more than 220 bushels of charcoal to the ton of iron; and taking the bushel to be 9.75 lbs., the amount of charcoal to a ton of iron would be 2,145 lbs., or 95 lbs. less than one ton, being about 4.8 times less than the quantity required by the above furnace.

The above per-centage of iron appears small when compared with my assay; but it must be remembered, that as no flux is used, every pound weight of silex will absorb and convert into slag 3 lbs. weight of iron.

Each furnace has three men attached to it, who dig out the ore in the first place, next cut their timber, and burn their charcoal, then draw the ore and coal to the village, set up their furnace, and smelt their iron. During this time they must run an account with the Bunnia (or Native merchant), and such account he manages shall swallow up the produce of their labour.

The cost of manufacture is as follows:—The ore purchased at the mines comes to 84 tokrees the rupee. I found 1 tokree to contain 12 lbs. nearly, the ore coming in round numbers to 4*s.* 6*d.* per ton nearly. Three men working at one furnace are able to make 24 lbs. of iron per day; it therefore requires 280 men to one ton of iron, by their rude process: then—

| | £ | *s.* | *d.* |
|---|---|---|---|
| 4 tons 12 cwt. of charcoal, with 8 cwt. for waste, at 9*s.* 4*d.*..... | 2 | 6 | 8 |
| 4½ tons of iron ore, at 4*s.* 6*d*..... | 1 | 0 | 3 |
| Labour, 280 men, at 2 annas (3*d.*) per day each ..... | 3 | 10 | 0 |
| | £6 | 16 | 11 |

The Bunnia's price for the iron is £7 15*s.* per ton, leaving him, as above, 18*s.* profit per ton.

As an illustration of an improvement in the manufacture of iron, even in these rough forges at Tendukheira (to be described further on), where the people are rendered industrious by having a greedy and ready market for their iron, any amount may be had for 20 seers the Nagpore rupee, or £4 16*s.* per ton nearly, notwithstanding that they bring their charcoal from a distance of 12 gond kos, or fully 36 miles. Yet, because they distribute their labour, and keep their little furnace in regular work, they are able to give iron at the above low price, and hundreds of tons are annually sent out through the country for consumption. Their charcoal only costs them 5*s.* 6*d.* per ton at the furnace; and yet the Lower Nerbudda workmen, with the timber on the spot, will charge 9*s.* 6*d.* per ton—their coalings are so very defective.

From Kautkot I went to Burwayee on the Nerbudda. Here is a large mine of the same ore as last, but more silicious.

As I consider the Ponassa and the Chandgur districts of by far the greatest commercial importance, I will not say more of the intervening country.

I arrived at Ponassa on the 12th of December, and examined a large deposit of dolomite (carbonate of lime and magnesia), which exists there, about two miles west of the town.

The deposit is, practically speaking, quite inexhaustible, the outcrop being four miles in length: the stone, for a flux, is superior to pure limestone, magnesia being a much more powerful base than lime. It is also well adapted to lithographic purposes.

From Ponassa I went to Chandgur, where the red hematite ore of iron abounds. It is of surpassing richness, yielding 63.4 per cent., the theoretically pure ore giving only 69.34 per cent.

At one of the mines (that marked as Upper Chandgur on plan), the ore lies in rounded nodules on the surface, the depth varying from six inches to ten feet. It is dug out by the people with the greatest facility.

This friable deposit is the result of the disintegration of the metalliferous rock beneath. I have verified this by direct observation, having laid bare several veins, by cutting trenches down on them.

In addition to the above loose ore, the ground for hundreds of acres is strewn with it, and every stream runs down quantities of the purest kind, the débris from the various veins intersected in their course.

The river Nerbudda cuts four great veins within the short space of one mile, one of them having a breadth of one hundred and twenty-two feet. The veins run almost vertically into either bank.

At Makeraban, on the river Towa, two miles from its junction with the Nerbudda, is another friable deposit; but its quality is not so good as that on the north side of the river. It is needless to dwell on the many places in the district where iron ore abounds;—the deposit may be looked upon as inexhaustible. Since I left Ponassa, Mr. Keatinge wished to find a mine close to the town, in order to employ the prisoners in the manufacture of iron, and having offered a reward of Rs. 25, he was shown two mines, which I have since examined. One of them is of much value.

Your superintendent, when he would be stationed in the district, would have no difficulty in laying bare deposits in addition to the very numerous ones which are at present known.

The loose ore, which ought to be the first used, would be collected by the people of the neighbourhood. Allowing the liberal price of 4 pies per tokree, the ore would be placed at the depôts at the low price of 1*s.* 3½*d.* per ton. My camp was four miles from the mine, and yet the villagers offered to bring any quantity to it for that price.

The district for miles round is dense jungle; the timber is of the highest specific gravity, including undian and stunted teak; it is admirably suited to the manufacture of charcoal; and the supply will last for very many years.

Yet it is well to know that a cheap communication can be opened with the

inexhaustible coal-measures of Hooshungabad and Nursingpoor (to be hereafter described), and that a line joining the coal with the iron mines would pass through a district of the most extraordinary fertility (vide Supplementary Report). I consider that, with proper coalings, charcoal cannot possibly cost more than 4*s.* per ton.

I would furnish you with an appropinquate estimate of the expense of manufacturing iron at Ponassa with proper apparatus, but I consider that the fact that the inhabitants of Tendukheira manufacture malleable iron for £4 16*s.* per ton, under much less favourable circumstances, consuming more than four times the requisite quantity of fuel, to be much more valuable than any estimate I could give.

Ponassa I would recommend as the proper site for an iron manufactory: it possesses the following advantages:—

1*st.*—It is on British territory.

2*nd.*—The soil about it is most fertile, the place healthy, and abundantly supplied with water at all seasons.

3*rd.*—It is most conveniently situated with regard to trade; the country around it flat; and should a line from the Taptee Valley branch to Jubbulpore be deemed advisable, it would pass in the vicinity; and the dolomite basin is close by.

The north bank of the river is foreign territory, and very barren; besides, the dense jungle would render it most unhealthy.

Your ore banks and mines would be ten miles distant from your works; but a proper road to them would enable you to draw the ore very cheaply, and the road being through jungle, your coalings would be along it.

One circumstance vastly in favour of these mines is, that no shaft or pumps would at any time be required, as the great veins can all be worked and drained by adits.

Baraj Sing, one of Sindia's petty Rajas, is owner of the mines and forests on the north side of the river, and he derives a small income from them of about £10 annually.

Kurrock Sing is owner of the royalty at the south side of the river, and he derives a small income of about £3; but I am informed by the Commissioner of the Saugor and Nerbudda Territories, that the Government will, in the approaching settlement, reserve all mines for their use.

With these men, negociations for purchase should be opened.

Leaving this iron district, I proceeded to the coal-field, which I entered above Sewnee.

At Sonadeh, several thin seams of coal outcrop, which, though of little value, are sufficiently indicative of a rich mine beneath; and I have no doubt but that a few deep borings would be attended with the most successful results.

Here an abundance of fine fire-clay is to be had,—a substance essential in the construction of your furnaces.

The probable available coal-measure here will be about fifteen miles long, by seven miles wide.

From Sonadeh I proceeded to Benar, in the Nursingpoor district, eight miles to the south of Garrilwara. Here are three workable seams, the topmost being eight feet thick where I measured it; but as the strata were there injured, it will probably reach ten feet.

The next seam is three feet six inches; and below it another seam, six feet three inches.

As these are only separated by laminated shale of one foot four inches, both seams could be wrought as one, giving an available seam of nine feet nine inches: thus about nineteen feet of coal could be worked from one shaft, the intervening rock being only about twenty feet.

The beds are highly inclined, owing to the occurrence of trachytic veins higher up the stream; but they will present no extraordinary difficulty in working.

It is highly bituminous lignite, containing little sulphur, and leaving but a small residue on incineration.

Colonel Ouseley, in the Journal of the Asiatic Society of Bengal, states that this coal was tried on the *Indus* steamer at Bombay, where one hundred maunds did the same work as one hundred and eighty-three of the best Glasgow coal, heating one of the boilers fifteen minutes sooner than the Scotch coal.

I carefully experimented upon the coal, and found that one hundred parts gave 66.88 of coke; an average of eleven specimens of coal from the various Newcastle collieries giving 60.77, and eight specimens from the Scotch collieries giving a mean of 54.23.

These seams are available throughout a large tract of country, and were a coast communication once opened, numerous other mines might be wrought throughout this great coal formation.

That such mines, discovered so far back as 1837, should still be untouched, speaks volumes for the state of communication through the country.

Leaving Benar, I went northward, to examine the iron mines of Tendukheira. They are situated about six miles from the Nerbudda, in a highly cultivated district.

As I before alluded to the smelting of the ore, I will confine my remarks to the mines themselves.

The ore is found beneath the surface, at depths varying from fifteen to fifty feet: the pits are so carelessly made, that they require to be re-dug every cold season, the monsoon rains quite filling them with the earth washed in.

The ore is extracted in quite as careless a manner as at Kautkot: the shaft is ascended and descended by huge steps, cut in the clay; and though now accustomed to the various rude expedients made use of by the Natives, I was hardly prepared for the ludicrous method by which the ore is brought to the surface. A woman seats herself at the base of the shaft, and then commences throwing up the lumps of ore to step No. 1 (about three feet high);

when this step is so covered with ore that she can but just find sitting room on it, she climbs up, repeats the process, till the ore is brought to the surface; it is then placed in baskets, and carried by buffaloes to the town, three miles distant, to be smelted. I confess I was much disappointed with the ore deposit, after seeing the vast quantities of iron sent out through the district round. Though very fine red hematite ore, it is vastly inferior to the Ponassa iron, both in quantity, quality, and in the facility afforded to the working.

It may appear strange that this rude method of extracting the ore should be accompanied by such a neat and systematic method of smelting; but I attribute the latter to Captain Franklin's exertions, who was sent there some years since by Government; while in the former case I presume his improvements (if such be adopted) must have lapsed into disuse. At all events, the great demand for the iron through the surrounding agricultural districts has given a stimulus to the trade, while the increased competition amongst producers has reduced the price of the manufactured article.

Leaving Tendukheira, I proceeded to examine the Jubbulpore district. Here I found large and rich deposits of the micaceous variety of specular iron. It is extensively wrought, holding the same price and position in the market as the iron of Tendukheira, the principal seat of manufacture being Penaghur, fifteen miles north-east of Jubbulpore.

At Betharee Ghat, the Nerbudda cuts a large coal seam; but it is highly pyritous, and the strata, being inclined at an angle of eighty degrees, is unconformably overlain by dolomite. The difficulties presented to working the seam render it probable that no use will ever be made of it.

I here found unmistakeable evidence of the presence of copper, but was unable to discover the lode.

A fine statuary marble is found lower down the Nerbudda, and the whole district is of the greatest interest, as well to the capitalist as to the geologist.

I have, &c.

(Signed) Arthur A. Jacob, B.A.,
Assist. Engr., and Geologist to the B. B. & C. I. R. Co.

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*Report by* Mr. Jacob, *in reference to the Line required to open up the Mineral Districts of the Nerbudda Valley.*

*Surat, April 4th,* 1854.

To Lieutenant Colonel J. P. Kennedy,
Engineer in Chief, and Managing Director.

Sir,

Having sent in my Report on the Mineral Districts of the Valley of the Nerbudda, I now beg to lay before you the result of my examination of the

physical features of the country with reference to the levels, &c., in order that you may from it form a correct idea of the best means of dispersing not only the mineral but the agricultural produce of these territories throughout India.

Aware of your intention of opening out the Valley of the Taptee, I will speak first of the junction between Julgaum and Ponassa, the proposed site for your ironworks; secondly, I will shortly refer to the line of country between Ponassa and Mundlaisir, with regard to the opening out of the Lower Nerbudda Valley; and finally, I will describe the line of country between Ponassa and Jubbulpore, with a view to the connection of the iron districts with the coal basins eastward, and to the affording of an outlet for the enormous grain and other produce of the valley, a large portion of which constantly rots for want of means of communication by which it could be brought to market. This line may also be considered as a portion of the connecting link between your main line and the Calcutta railway.

From Julgaum to Boorhanpoor is, as far as I could observe, a comparatively easy country: good gradients can, I am of opinion, be had all through it.

Boorhanpoor is a large, wealthy, and populous city.

The main question to be settled, on a minute examination, will be the precise point for passing the Taptee.

Proceeding then north-east, Asseerghur should be passed at a few miles east of the fort, where the Satpoora range is much broken, and affords an easy passage. Thence to Peepleod, a distance of fifteen miles, no difficulty will be found of any moment, and the country becomes more fertile. Twenty-one miles further on the branch to your ironworks would probably join, turning off toward Moondee, and crossing the Towa on a fine rocky bottom, without any difficulty. This branch would be about sixteen miles in length, and probably its extension across the Nerbudda to Indore will be a matter of future consideration, opening out, as it would, the great iron country further from Ponassa.

At Sakur, where it would probably cross the Nerbudda, the fine-weather breadth of the river is but forty-eight feet; and I do not hesitate to say that it affords the best site for a bridge throughout the two hundred and eighty miles of that river which I have examined, save, perhaps, Jhansee Ghat, near Jubbulpore (to be described further on).

The line of country from Ponassa to Mundlaisir (about forty-eight miles), presents easy gradients; no difficult rivers are crossed, and Burwayee, a fine town half-way, would afford considerable traffic.

The Nerbudda line, after passing the Ponassa junction, should diverge in a straight line to Hurda, a further distance of twenty-eight miles. Here is the commencement of a district of endless fertility and unknown wealth; and, if the little ravines on the edges of the very few nullas to be met be excepted, the country may be considered level.

Hurda is a large town, carrying on a flourishing trade, as far as the wretched communications of the country will admit. It sends down quantities of cotton every season to Bombay. I am informed by Mr. Keatinge, the Political

Agent of Nimar, that cotton carts passed Asseerghur during the last season at the rate of two hundred per day.

Crossing the Gungal river at a distance of eighteen miles, Sewnee will be reached seven miles and a half further on.

This is, again, a fine business town.

I would not recommend a divergence from the straight line toward Hooshungabad, as that town, though large, would not, I think, have sufficient traffic to authorise such divergence; and the river Towa, a troublesome stream, would near Hooshungabad be passed with much difficulty. It would be better to continue straight to Patroda: the line would pass near the Sonadeh coal-field (see Geological Report), and it is probable that valuable coal mines will be found between Sewnee and Patroda.

At Patroda the Hooshungabad road is crossed. Quantities of opium will here be taken up from the Baitool district, and abundance of teak timber of fine scantling can be had in the hills south of the line.

From Patroda to Sohagpoor is about twenty miles, the Towa river being passed half-way. This is the first troublesome river to be passed; the bed is deep sand, and about three quarters of a mile wide.

Keeping above the town of Sohagpoor, the line would still pass through a most fertile and populous country for fifty miles, where the Benar coal mine would be reached (vide Geological Report).

Garrilwara is about twelve miles north of the coal mine: it is a fine populous town. From this to Nursingpoor is twenty-three miles: this is another large town.

From Nursingpoor to Jhansee will be twenty-seven miles: the line, passing under the hills, would cross the Nerbudda at Jhansee Ghat, where a fine site for a bridge is to be obtained about five hundred yards below the Jubbulpore road.

The river is about six hundred feet wide, and fordable; the banks high; the bottom is a fine flat-bedded sandstone, nearly horizontal; and should timber be required for centering or superstructure, the finest teak can be floated down from the Jubbulpore jungle.

There will be no ravines crossed on the south bank of the Nerbudda, as the line will run along a strip of high land between two tributaries; but on the north bank they will be troublesome for the first half mile.

Twenty-three miles from this, Jubbulpore will be reached without the least difficulty.

The lateness of the season prevented me from continuing my examination toward the Ganges.

Throughout this whole line, no gradient, I am convinced, will exceed sixteen feet to the mile, and the only gradients coming at all near this are those in the vicinity of Asseerghur.

As a practical proof of the cheapness of provisions of every kind, I was enabled, while about the Hooshungabad and Nursingpoor districts, to feed

three ponies and myself for the small sum of Rs. 23 per month ; and I did not act ungenerously either to myself or them.

The land bears two crops per year, without manure. After the monsoon, jowaree, bajree, &c. are sown, and they being removed in November, wheat, gram, linseed, &c. are sown.

The demand is so small for the grain, that it lies in deep holes in the ground for years, and frequently rots there.

Wheat may be had for 90 seers the rupee, and gram for 120 seers the rupee.

Sugar is largely sent from Mirzapore westward, and salt, English and other goods, are carried eastward.

In Jubbulpore, lac is largely manufactured for the English market; and, as I have stated in my Geological Report, its mineral resources must make it a place of vast commercial importance.

I have, &c.

(Signed) Arthur A. Jacob, B.A.,
Assist. Engr., and Geologist to the B. B. & C. I. R. Co.

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## *Report on the Nerbudda River by* Mr. J. T. Green, *First Assistant Engineer to the Bombay, Baroda, and Central India Railway Company.*

*Banks.*—The north bank, east and west of Broach, is high and precipitous, showing evident indications of the encroachment of the river during the period of floods ; and by information obtained from the inhabitants, this wearing away is to the extent of thirty feet in a period of twenty years. The upper stratum of this bank is black earth, three to four feet thick, under which are alternate layers of sand and clay, varying from two to eight feet thick, mixed with kunkur (specimen forwarded); twelve feet from the bed of the river, the clay becomes hard and tenacious, and appears to resist the action of the flood very considerably.

The south bank is low and shelving, about twenty-one feet above the summer level of the river; the upper stratum alluvial deposit of earth and sand, in parts cultivated, and in others covered with low jungle, extending a distance of more than a mile, to a former channel of the river, when the bank again rises abruptly.

*Floods* are of two descriptions,—those occurring annually, during the periodical rains ; and rapid freshes at the same season, owing, probably, to the combined influence of a heavy fall of rain, a strong westerly wind, and high spring tides.

The highest known rise of flood took place seventeen years since, by the account of the inhabitants, and appears to correspond with the great flood

mentioned in the Report of the Taptee river, namely in the month of August 1837. The country in the vicinity of the river is spoken of as being entirely under water, except solitary knolls, upon which human beings and cattle congregated. This inundation, similar to the Taptee river, took a period of three days to attain its greatest height, and subsided in one, remaining nearly stationary twenty-four hours. With regard to the extent of country which was flooded, no positive information can be obtained ; there is a prevalent report that the waters of the Taptee and Nerbudda joined, which, if true, would make it about forty miles.

Large quantities of drift timber, and grass, bushes, tops of houses, and cattle, are brought down during the period of periodical floods, and which is considerably increased upon a sudden rise in the river : tigers, bears, and several descriptions of deer, are also frequently brought down, together with a large number of snakes.

The nature of the deposit, after the floods have subsided, is alternate layers of and and clay, as regularly as if deposited by human aid. Some of the layers vary in thickness, owing to the freshes being less at one time than another.

*Velocity of Current.*—The velocity was observed when the river was free from tidal water, and at summer level : the mean of three observations gives 1.23 feet per second, or 4,428 feet per hour,—less than one mile.

*Borings* have been made in four places,—one on the north side, between high and low-water, one in the centre of the river, and two on the south side. A reference to the accompanying section will explain the different strata penetrated : no stones, gravel, or pebbles were met with on the north side,—the clay is very tenacious ; the sand and gravel found in the centre boring is compact and firm ; that on the south side becomes firm after the first ten feet is passed through ; and I have no hesitation in stating that screws of four feet flange will both enter the different strata with facility, and at a depth of twenty feet be found to afford a good and sufficient support for any structure.

The drift timber brought down in inundations is of considerable size and quantity ; and on this account I would beg to suggest that the water may be left as wide as possible,—a span of eighty feet would not, I conceive, be more than sufficient. The number and size of piles used in each pier will of course be regulated by the span decided upon, and consequent weight to be borne by such pier. Cylindrical tubular piles of wrought-iron, with screws of four feet flange, will, I believe, be found the best adapted for piers in both the Taptee and Nerbudda rivers,—the modification to be made in the screws used in the former, as described in the Report thereon.

(Signed) J. T. Green,
First Assistant Engineer.

*Surat, 4th April* 1854.

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